Hedging Against Inflation: Housing vs. Equity

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Abstract

To which extent do equity and housing hedge against inflation? Despite an extensive literature, there is only little consensus. This paper presents new evidence from the Jordà-Schularick-Taylor Macrohistory Database, which covers return rates on housing and equity as well as consumer price indices of 16 developed countries from 1870 - 2015. The results depend on the time horizon and period considered. Within one, five, and ten years housing hedges, at least partly, against inflation and the hedge has been better in the post-war period. In the long run housing provides an excessive hedge in the whole sample and a perfect hedge in the post-war period. Equity provides no hedge within one-year in the whole sample period and the returns tend to decrease with inflation in the post-war period. The hedge improves slightly with a longer time horizon and is perfect in the long run in the post-war period. Thus, housing is, at least weakly, superior in hedging against inflation. The results are robust to a non-housing consumption price index and an asset price appreciation approach.

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1 Introduction

For a majority of households, housing and equities are the most important real assets. They represent more than half of the total assets in household balance sheets (see Jordà et al., 2019). Thus, changes in the real value of those assets have important implications for a large fraction of households and, as a consequence, for the whole economy. As both assets are real assets or claims on them, their nominal returns should keep pace with inflation and in this way hedge against general price shocks. However, Fama and Schwert (1977) found that the nominal return on equity declines if inflation increases, whereas the nominal return on housing keeps pace with inflation. Their paper has established a strand of the literature on the 'stock-return inflation puzzle'. As the estimated relation between inflation and the nominal return on housing is in line with theory, this relation has received less attention. A lack of data additionally explains the sparse knowledge on the housing returns-inflation relation. Given the fact that a much larger share of the population owns residential real estate than equities (see e.g. Kuhn et al., 2020), this sparse knowledge is unfortunate. Besides, even though there is extensive literature on hedging against inflation, there is only little consensus and an ongoing debate in finance and economics on the subject.

The Macrohistory Database built by Jordà-Schularick-Taylor (JST) (Jordà et al., 2017, 2019) provides the opportunity to shed new light on the equity return-inflation relation, and, more importantly, to compare the relative performance of equity and housing as inflation hedges. The database provides transaction based annual return rates on housing and equity as well as Consumer Price Indices (CPIs) of 16 countries from 1870 till 2015. To the best of my knowledge, the present study is the first using the JST Macrohistory Database to measure return-inflation relations.

To examine the return-inflation relation in the short and medium run, the study presents results from linear regressions of nominal returns on CPI inflation rates. These regressions run on an annual frequency as well as on a five and a ten years moving-average in line with Boudoukh and Richardson (1993). Cointegration analysis and vector error correction models (VECMs) illustrate the long-run relation and dynamics between nominal returns and inflation. The estimates refer to both the country level and the panel as a whole.[1] The analysis disregards more sophisticated modern time series estimation methods for two

[1] Pedroni (2019) gives a good introduction in panel cointegration techniques and Canova and Ciccarelli (2013) to panel VARs. The VECM results are presented only for the whole panel.

reasons. First, they require typically a higher frequency than an annual one. Second, they are less well-known and therefore come at the expense of being readily comprehensible to a broad readership.[2] The paper presents results for the *full* sample and the *post-war* period. The pre-world war sample by itself is too small due to missing values.

The following definitions are stated for the extent of hedging. Nominal returns that increase one-to-one with inflation fully hedge against inflation. Those that increase less or more than one-to-one provide a partial or excessive hedge, and those that decrease with increasing inflation are a hazard rather than a hedge. Inflation-independent nominal returns provide no hedge at all. The estimation results can be summarized as follows. In the short run housing hedges, at least partly, against inflation in virtually all countries. In the medium run, the relationship is on average higher in comparison to the short run and the panel estimates cannot reject a one-by-one relation in the *post-war* period at the 5% level. Equity does not provide a hedge against inflation in the short run and in the *post-war* sample equity tends rather to be a hazard. In the medium run, the equity return-inflation relationship estimates increase on average in comparison to the short run and, as in the short run, the estimates tend to be smaller in the *post-war* sample in comparison to the *full* sample.

In the long run, housing is an excessive hedge in the *full* sample and a perfect hedge in the *post-war* sample. Equity hedges partially against inflation in the *full* sample and perfectly in the *post-war* sample. The impulse response functions (IRFs) of the VECMs show that the transition to the new equilibrium takes about 10 years for housing and about 20 years for equity in both samples on average across all countries.

Based on pooled OLS (POLS) estimation, the hypothesis that equity and housing hedge equally well against inflation in the short- and medium run must be rejected on the 5% level. Thus, housing is superior to equity in hedging against inflation in the short and medium run as well as weakly superior in the long run. Moreover, in the medium run inflation accounts for a large fraction of the variation in housing returns, but not in equity returns. The results are robust when addressing the critique of Anari and Kolari (2002) that the simultaneous causality bias can arise regarding housing, as the rent determines the yield of housing and a large fraction of the CPI.

There is a large literature on inflation hedging. Arnold and Auer (2015) give an overview

[2]Of course a broad readership may not be an inherent objective of a study. However, since the nominal return-inflation relationship relates to many fields in economics and finance and this relationship is being studied for the first time for the dataset, a broad readership becomes an objective.

of the state of scientific knowledge on inflation hedging for major asset classes and Madadpour and Asgari (2019) for the 'stock-return inflation puzzle'. Instead of giving a broad literature overview here, I refer to both surveys and discuss my findings in terms of those surveys. In summary, the equity return-inflation relation is considered to be negative to non-existent in the short run and positive at horizons of at least five years. However, these results still lack consensus because the particular studies differ along several dimensions, such as methodologies, time horizons, data sources, country coverage, sampling periods, and frequencies. The present results support previous results by applying common methods for various time horizons with reference to one data source of 16 countries, all with a similar sample period and a uniform frequency.

The consensus concerning the housing return-inflation rate is even more vague. In addition to the problems encountered in the review of the stock return-inflation, there are two more problems: a frequent mix of commercial and residential real estate and deficient information in general. The few studies relying on transaction-based housing returns are comparable to the analysis at hand. Brounen et al. (2013) investigate the inflation, house price and rents relationship in Amsterdam from 1814 - 2008. They find housing protects against inflation, especially in the long run. Anari and Kolari (2002) and Christou et al. (2018) investigate the house price-inflation relation in the U.S. in the post-war period. They find also housing hedges, at least to some extent, in the long run. The present paper supports these findings using what Jordà et al. (2019) claim to be the longest and most comprehensive cross-section total housing return panel. Additionally, I examine the time horizon dependence and verify the hypothesis that both housing and equity hedge equally against inflation in the short and medium run, which is rejected.

Due to high transaction costs and the absence of organized markets housing is poorly readily and frequently tradeable, and, therefore, an inept hedging instrument in the very short run. These frictions imply that the frequency of the data is sufficient for the investigation of the housing return-inflation relation. However, these frictions also imply that the present study is more relevant for investment decisions with a longer time horizon. These are, in particular, the households' existential investment decisions: diversifying life-cycle savings and the decision to become a homeowner. The former is inherently a lifetime investment decision; for the latter, note that Brounen et al. (2013) report that on average homeowners inhabit the same house for 12 years and according to Marlay and Fields (2010) more than 90%, 65%, and 45% of homeowners lived in their current home for more than one year, 5 years, and 10 years, respectively in the U.S. in 2004.[3] The relevance of the present study for households is reinforced by the mentioned fact that equity and housing are their most important real assets.

The remainder reads as follows: The next section considers the theoretical reasoning behind inflation hedging and introduces the reader to the properties of the data. The three sections thereafter consider the short-run (one year), the medium-run (five and ten years), and the long-run (cointegration) return-inflation relation. Each section first describes and motivates the estimation strategy and subsequently presents the results for the *whole* and the *post-war* period. Section 6 presents impulse response estimates that highlight the dynamics of the adjustment of nominal returns in response to an inflation shock. Section 7 and the respective Tables in the Appendix address the concern of a simultaneity bias by repeating the whole analysis with two different approaches. The first one employs a consumer price index without expenditures on housing and the second one with nominal returns that include only capital gains using asset price indices.[4] Section 8 concludes. The Appendix also presents results from the Fama and Schwert (1977) approach, who distinguish between expected and unexpected inflation.

2 Preliminaries

2.1 Theory

The Fisher hypothesis constitutes the basis for the hypothetical relation between nominal asset returns and inflation. The theory states as follows: Once all information about future inflation is priced into markets, the expected nominal return on an asset is the sum of the expected real return and the expected inflation. In this case, an asset is an ex-ante hedge against inflation. Potentially, housing and equity hedge also against unexpected inflation. The intuition behind the relation to unexpected inflation is straightforward. Since housing and equity are real assets or claims on them, the nominal values of such assets and the nominal yields from operations relating to these assets are expected to keep pace with inflation. In this case, an asset is an ex-post hedge against inflation.

The choice of ex-ante or ex-post analysis is on the one hand a question of the investigation framework. E.g. to assess the efficient market hypothesis, the ex-ante approach

[3]The duration of living in current owner-occupied residence also serves to assign a weighting to the selected intervals of the short and medium term.

[4]Simply put, the latter evaluates the asset price-inflation relation.

should be adopted. On the other hand, it is a question of data availability and quality, as realizations can be quantified more precisely than expectations. For this reason, the focus here is on an ex-post analysis and the research question is which of the two assets, housing and equity, has performed better in the past as a hedge against inflation. Since this question is primarily of interest at the household level, the CPI is the natural choice for measuring inflation. Other interpretations to the object under investigation are more academic, namely the verification of the ex-post Fisher theorem as well as the relationship between inflation and real economic values. Methods to decompose inflation in an expected and unexpected part apply in Appendix C to gain additional insights in the return rates-inflation relationship.

The two assets differ primarily in three points. First, housing yields are the rents paid by tenants or imputed to home owners, which are included in the CPI basket. Dividends, the yield of equity, are paid by firms that operate in all sectors of the economy. Accordingly, they should keep pace with the GDP-deflator whereas rents should raise one-to-one with the costs of housing. Second, shareholders are net debtors on average and bonds are issued nominally. Thus, shareholders benefit from unexpected inflation. The return on housing is not leveraged as it is measured as the rental income plus gains from house price changes. Third, housing operations, but not the operations of many companies, are spatially tied to the corresponding currency area. Therefore, the response of the real exchange rate to an inflation shock plays a role as to whether the return on equity keeps pace with inflation. The reverse conclusion gives the reason why a domestic asset analysis is sufficient. The validity of the purchasing-power parity theory determines mainly whether foreign assets protect against domestic inflation, which is yet another research question.[5]

To measure the extent of hedging, the relation of the return and inflation rates as well as the CPI elasticity of the assets' performance indices are estimated. The former applies to the short- and medium run (one, five, and ten years), the latter to the long run and for dynamics (cointegration testing and VECM). Both estimates can then be related to the definitions mentioned above as follows. Estimates greater one define an excessive hedge, equal one a perfect hedge, between zero and one a partial hedge, equal to zero no hedge, and smaller than zero define a hazard.

Table 1: Data availability

Country	ISO	Return on Housing	Return on Equity	CPI
Australia	AUS	1901 – 2015	1870 – 2015	1870 – 2016
Belgium	BEL	1890 – 1964 1976 – 2015	1870 – 2015	1870 – 2016
Canada	CAN	–	–	1870 – 2015
Denmark	DNK	1876 – 2015	1873 – 2015	1870 – 2016
Finland	FIN	1920 – 1926 1928 – 1944 1946 – 2015	1896 – 2015	1870 – 2016
France	FRA	1871 – 2015	1870 – 2015	1870 – 2016
Germany	DEU	1871 – 1914 1925 – 1938 1963 – 2015	1870 – 2015	1870 – 2016
Italy	ITA	1928 – 1938 1946 – 2015	1870 – 2015	1870 – 2016
Japan	JPN	1931-1944 1960 – 2015	1886 – 1945 1948 – 2015	1870 – 2016
Netherlands	NLD	1871 – 2015	1900 – 2015	1870 – 2016
Norway	NOR	1871 – 2015	1881 – 2015	1870 – 2016
Portugal	PRT	1948 – 2015	1871 – 2015	1870 – 2016
Spain	ESP	1901 – 2015	1900 – 2015	1870 – 2016
Sweden	SWE	1883 – 2015	1871 – 2015	1870 – 2016
Switzerland	CHE	1902 – 2015	1900 – 2015	1870 – 2016
United Kingdom	GBR	1896 – 1939 1947 – 2015	1871 – 2015	1870 – 2016
USA	USA	1891 – 2015	1872 – 2015	1870 – 2016

2.2 Data

This section starts with a description of the data source and in addition the preparation and manipulation. Then, the existence of necessary condition of integrated time-series for co-integration analysis and the necessary condition of stationarity for 'standard' regression analysis is tested. The section ends with a short visual data examination.

If not stated otherwise, the data is from the JST Macrohistory Database (see generally Jordà et al. (2017) and in particular for asset return rates Jordà et al. (2019)). This database brings together macroeconomic data from various sources and hitherto unavailable variables on asset return rates. The database covers 17 economies from 1870 till 2015 on an annual basis. Albeit, for some countries individual data points for return rates are missing and in their entirety for Canada. Table 1 illustrates the availability of the time-series used in this study and how to deal with missing values is discussed below.

Two points should be made regarding housing returns. First, the return rates include imputed rents of owner-occupied properties. The imputation is important, as an own-occupied property is by definition a perfect hedge against increasing rental rates. Second, the rent series rely on the rent component of CPIs. This is critical, because it potentially creates a simultaneous causality bias. To address the the potential bias, two robustness checks are made in this paper. The first relies on a constructed non-housing CPI, the second excludes rents from the return rates. The latter procedure results in asset price indices and thus, contributes to the literature on asset price-inflation relation. Further, Canadian data is available for asset price indices. Further, in the case of cointegrated time series, the estimators are consistent despite simultaneous causality.

To ensure comparability between housing and equity within a country, the study covers the same periods for both assets. As a consequence, it is necessary to select the latest start of the time series. The performance index at time t is constructed as the cumulative product of gross returns (1+return) from 0 to t. In order to not omit too many data, return rates are interpolated between individual dates. Similarly, the growth rates of the CPI at time t results in the inflation rate at time t.

Table 2 reports p-values of the ADF-test for a unit-root and the KPSS-test for stationarity

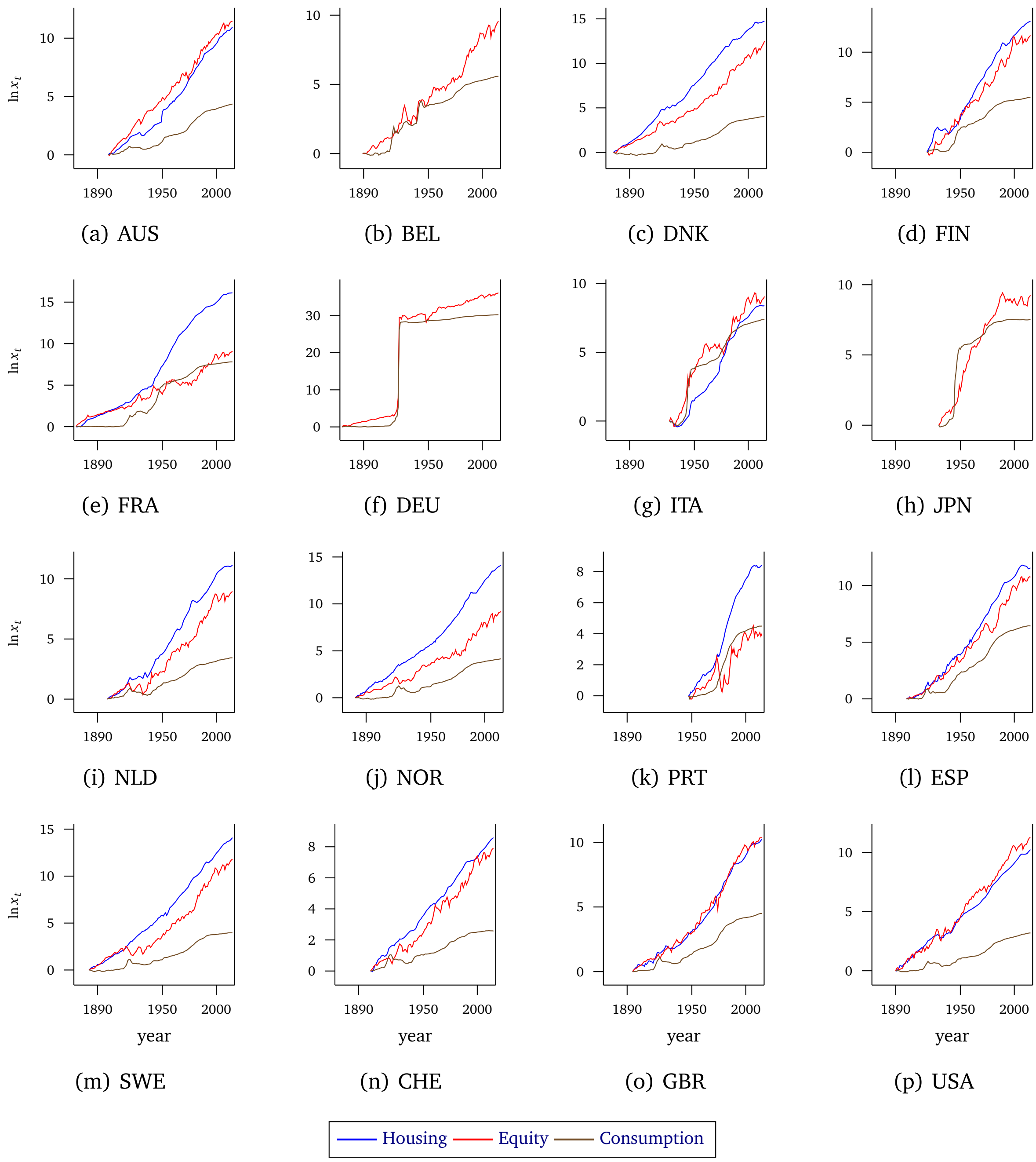
[5] Taylor (2002) studies the purchasing-power parity theory with JST Macrohistory Database related data.

for each country as well as the interelated ADF-χ-Fisher and Hadri-test for the whole panel of the natural logarithm of housing performance index (HPI), equity performance index (EPI), and CPI. The tests challenge the usability of the HPI of Belgium, Portugal, and Sweden as well as the EPI of Finland and Portugal, which is why the respective time-series is omitted in the cointegration analysis. Additionally, the HPIs of Belgium, Germany, and Japan are ignored due to a high number of imputed data. For the *post-war* period, the HPI of Sweden becomes usable (Appendix Table 34).

Table 3 reports the first differences of the natural logarithm of the constructed HPI, EPI, and CPI. Besides for the Portuguese CPI the hypothesis of a uni-root can be rejected on the country level at the 5% level and for the whole panel at the 1% level. Thus, 'standard' regression analysis of the return and inflation rates are feasible. Albeit, the estimates for Portugal should be viewed with caution. Stationarity becomes more questionable for the *post-war* period (Appendix Table 35) on the individual country level. Albeit, due to the short-time series, the power of the unit-root tests on the individual country level is low and the unit-root hypothesis can be rejected for the whole panel at the 1% level.

Figure 1 shows the indices, except the sparse HPIs of Belgium, Germany and Japan. First, except the Portuguese EPI (panel (k)), all performance indices exceed the CPI in the long run. Second, in Germany around the time of the hyperinflation in 1923, the EPI kept pace with consumer prices. Unfortunately, no data is available for the German return on housing during that time. Knoll et al. (2017) describe a striking house price behavior during that period as a result of persistent rental controls, resulting in negative return rates. Figure 2 illustrates the used return and inflation rates. It turns out that the return on equity is highly volatile in comparison to the return on housing and inflation.

Figure 1: Available Indices



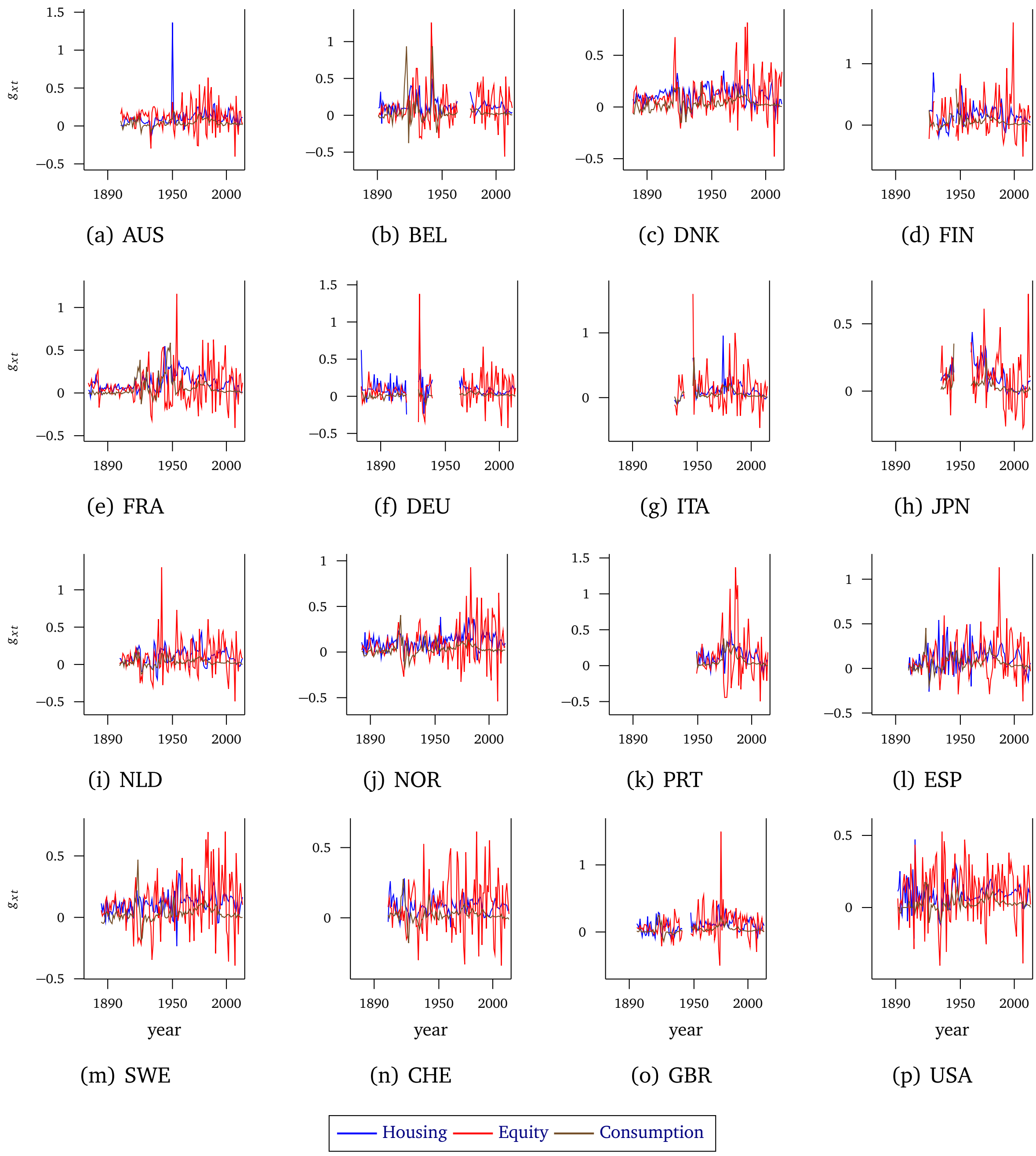
(a) AUS (b) BEL (c) DNK (d) FIN

(e) FRA (f) DEU (g) ITA (h) JPN

(i) NLD (j) NOR (k) PRT (l) ESP

(m) SWE (n) CHE (o) GBR (p) USA

Figure 2: Available Indices' Growth Rates



(a) AUS (b) BEL (c) DNK (d) FIN
(e) FRA (f) DEU (g) ITA (h) JPN
(i) NLD (j) NOR (k) PRT (l) ESP
(m) SWE (n) CHE (o) GBR (p) USA

Table 2: Unit-root tests

	H_0: Unit-root			H_0: Stationarity			
	P_H	P_E	P_C	P_H	P_E	P_C	T
AUS	0.24	0.07	0.71	0.01	0.02	0.01	116
BEL	0.03	0.07	0.33	0.1	0.03	0.02	127
DNK	0.7	0.62	0.34	0.05	0.01	0.01	141
FIN	0.8	0	0.76	0.1	0.1	0.05	97
FRA	0.89	0.6	0.64	0.01	0.04	0.04	146
DEU	0.87	0.85	0.9	0.1	0.02	0.02	146
ITA	0.55	0.82	0.66	0.1	0.08	0.04	89
JPN	0.65	0.56	0.56	0.02	0.01	0.02	86
NLD	0.55	0.62	0.66	0.01	0.01	0.04	117
NOR	0.07	0.66	0.33	0.01	0.01	0.01	136
PRT	0.87	0.12	0.48	0.1	0.1	0.1	69
ESP	0.55	0.16	0.61	0.01	0.01	0.03	116
SWE	0.01	0.66	0.34	0.01	0.01	0.01	134
CHE	0.18	0.34	0.09	0.07	0.02	0.09	115
GBR	0.48	0.63	0.53	0.01	0.01	0.01	121
USA	0.75	0.31	0.43	0.01	0.02	0.01	126
GME	0.95	0.09	0.82	0	0	0	1882

P_x : for ISO: p-values of the ADF-test for the unit-root test and KPSS-test for stationarity and for GME: p-values of the ADF-Chi-Fisher and Hadri-test, respectively. Lag length selection rests on Bayesian information criterion. H: HPI, E: EPI, C: CPI.

Table 3: Unit-root tests (first differences)

	H_0: Unit-root			H_0: Stationarity			
	P_H	P_E	P_C	P_H	P_E	P_C	T
AUS	0	0	0	0.1	0.1	0.1	115
BEL	0	0	0	0.1	0.1	0.1	126
DNK	0	0	0	0.06	0.1	0.1	140
FIN	0	0	0.05	0.1	0.1	0.1	96
FRA	0	0	0	0.01	0.1	0.04	145
DEU	0	0	0	0.1	0.1	0.1	145
ITA	0	0	0	0.04	0.1	0.1	88
JPN	0.03	0	0	0.03	0.1	0.1	85
NLD	0	0	0	0.08	0.1	0.1	116
NOR	0	0	0	0.1	0.1	0.1	135
PRT	0	0	0.71	0.03	0.1	0.02	68
ESP	0	0	0	0.02	0.1	0.05	115
SWE	0	0	0	0.09	0.1	0.1	133
CHE	0	0	0	0.1	0.1	0.1	114
GBR	0	0	0	0.1	0.1	0.1	120
USA	0	0	0	0.1	0.1	0.1	125
GME	0	0	0	0	0.88	0.78	1866

P_x : for ISO: p-values of the ADF-test for the unit-root test and KPSS-test for stationarity and for GME: p-values of the ADF-Chi-Fisher and Hadri-test, respectively. Lag length selection rests on Bayesian information criterion. H: HPI, E: EPI, C: CPI.

3 Hedging in the short run

3.1 Estimation strategy

To examine the contemporaneous relationship between return rates and the inflation rate I regress

$$r_{ixt+1} = \alpha_{ix} + \beta_{ix}\pi_{it+1} + e_{ixt+1},\ x \in \{H, E\},\ i = \{\text{ISO}\},\ t = 1, ..., T_i, \tag{1}$$

where r_{ixt+1} is the return on housing ($x = H$) and equity ($x = E$) and π_{it+1} the inflation rate of country i at the time $t+1$. The estimator of the parameters $\hat{\theta}_i = [\hat{\alpha}_{iH}, \hat{\alpha}_{iE}, \hat{\beta}_{iH}, \hat{\beta}_{iE}]$ is calculated via ordinary least squares (OLS), if not otherwise stated. The panel structure is used by applying the group mean estimator (GME) and the POLS estimator. As fixed and random effects models are inappropriate for small $N (= 16)$, regressing model (1) via POLS ($\hat{\theta}^{POLS} = \hat{\theta}_i$, for all i) seems the most suitable estimator for heterogeneous panels in the static case. Pesaran and Smith (1995) report that pooling gives potentially misleading estimates in the dynamic case, while the GME is consistent. Therefore, to apply a common estimator for all time horizons, I report also the GME results. The variance-covariance estimates of the OLS and POLS estimators are heteroskedasticity and autocorrelation consistent by applying the Newey-West estimator with $(4T/100)^{2/9}$ lags. Chudik and Pesaran (2019) show that $\hat{\Omega}_{GME} = (1/(N-1)) \sum_i^N (\hat{\theta}_i - \hat{\theta}_{GME})(\hat{\theta}_i - \hat{\theta}_{GME})'$ is a consistent estimator of the variance-covariance matrix of the GME $\hat{\theta}_{GME} = (1/N) \sum_i^N \hat{\theta}_i$, even if the individual estimators $\hat{\theta}_i$ are weakly cross-correlated. Finally, I test individually and for the whole panel the hypothesis: $H_0 : \beta_H = \beta_E$ against $\beta_H \neq \beta_E$. The statistic is $t_j = \sqrt{T_j}(\hat{\beta}_{jH} - \hat{\beta}_{jE})/\hat{\sigma}_{j(\hat{\beta}_H - \hat{\beta}_E)}$ with $\hat{\sigma}_{j(\hat{\beta}_H - \hat{\beta}_E)} = \widehat{Var}(\hat{\beta}_{jH}) + \widehat{Var}(\hat{\beta}_{jE}) - 2\widehat{Cov}(\hat{\beta}_{jH}, \hat{\beta}_{jE})$ and $j \in \{\text{ISO, GME, POLS}\}$.

3.2 Results

Table 4 presents for the *full* sample the point estimates of the parameters $\hat{\theta}_i$ of equation (1), the standard deviations of the estimators $\hat{\beta}_{xi}$, the p-value of the hypothesis $H_0 : \beta_H = \beta_E$, the coefficients of determination, and the number of data points.

Concerning the return on housing it turns out that the $\hat{\beta}_H \pm 2\hat{\sigma}_{\beta_H}$-confidence intervals of the estimates do not include the zero, except in Belgium and barely in Switzerland. The interval of seven countries as well as of the GME includes the one. Concerning the return on equity it turns out that the $\hat{\beta}_E \pm 2\hat{\sigma}_{\beta_E}$-confidence intervals of the estimates all include

Table 4: Hedging within one year

	$\hat{\alpha}_H$	$\hat{\beta}_H$	$\hat{\sigma}_{\beta_H}$	$\hat{\alpha}_E$	$\hat{\beta}_E$	$\hat{\sigma}_{\beta_E}$	$P_{\beta_H=\beta_E}$	R^2_H	R^2_E	T
AUS	0.07	1.01	0.27	0.12	-0.12	0.41	0.01	0.11	0	114
BEL	0.11	0.15	0.11	0.09	0.4	0.26	0.27	0.07	0.07	113
DNK	0.1	0.51	0.12	0.09	0.68	0.29	0.38	0.15	0.05	139
FIN	0.13	0.51	0.23	0.2	-0.66	0.41	0	0.05	0.02	91
FRA	0.1	0.35	0.1	0.09	-0.11	0.14	0	0.15	0	144
DEU	0.08	0.94	0.33	0.09	-0.11	0.8	0.09	0.07	0	110
ITA	0.04	1.08	0.27	0.12	-0.28	0.38	0	0.45	0.01	79
JPN	0.07	0.74	0.28	0.09	0.02	0.29	0.02	0.2	0	68
NLD	0.08	0.87	0.23	0.08	0.63	0.58	0.25	0.16	0.02	115
NOR	0.1	0.38	0.1	0.08	0.24	0.23	0.22	0.09	0.01	134
PRT	0.08	0.78	0.17	0.14	-0.37	0.63	0.02	0.39	0.01	67
ESP	0.07	0.65	0.12	0.12	-0.01	0.26	0.01	0.14	0	114
SWE	0.11	0.21	0.1	0.11	0.1	0.4	0.28	0.03	0	132
CHE	0.07	0.26	0.13	0.09	-0.2	0.26	0.07	0.05	0	113
GBR	0.07	0.63	0.18	0.08	0.6	0.6	0.33	0.13	0.03	112
USA	0.07	0.61	0.22	0.12	-0.5	0.48	0	0.11	0.01	124
GME	0.08	0.6	0.28	0.11	0.02	0.39	0.11	–	–	–
POLS	0.09	0.44	0.08	0.1	0.12	0.17	0.03	0.11	0	1769

$\hat{\alpha}_x, \hat{\beta}_x$: Parameter estimates of equation (1), $\hat{\sigma}_{\beta_x}$: standard deviation of $\hat{\beta}_x$, $P_{\beta_H=\beta_E}$: p-value of the test $H_0 : \beta_H = \beta_E$ against $\beta_H \neq \beta_E$, R^2_x: coefficients of determination, T: Number of data points. $\hat{\sigma}_{\beta_x}$ are heteroskedasticity and autocorrelation consistent by allying the Newey-West estimator (Lags $= (4T/100)^{2/9}$) for OLS and POLS and consistent for weakly cross-correlated estimators $\hat{\theta}_i$ for GME.

the zero, except for Denmark, which includes the one. For half of the countries and the POLS estimation, the null must be rejected on a 5% significance level that both investment types hedge against inflation to the same extent. The R-squares are both small and the one concerning equity tends to be smaller.

Table 5 presents the previous information for the *post-war* sample. Concerning housing, the variation of the particular β_H-estimators increase in comparison to the *full* sample, apparent from the higher standard deviation of the GME. Albeit, both panel estimators increase and the standard deviation of the POLS estimator persists. Concerning equity, the variance within and between the estimators increases. The point estimators of β_E decrease on average by 0.56 and the POLS estimator by 0.42. As a result, for eleven countries and for the POLS estimation, the null of $\beta_H = \beta_E$ must be rejected at the 5% level. The R-squares are similar to those in the *full* sample.

To summarize the within one-year horizon, housing hedges unlike equity at least partly against inflation and inflation does not account much for the variation of the nominal return rates. The results are more solid for the *post-war* sample.

Table 5: Hedging within one year (post 1950)

	$\hat{\alpha}_H$	$\hat{\beta}_H$	$\hat{\sigma}_{\beta_H}$	$\hat{\alpha}_E$	$\hat{\beta}_E$	$\hat{\sigma}_{\beta_E}$	$P_{\beta_H=\beta_E}$	R^2_H	R^2_E	T
AUS	0.09	0.98	0.38	0.15	-0.38	0.54	0.02	0.07	0.01	66
BEL	0.11	0	0.54	0.13	0.02	1.53	0.34	0	0	54
DNK	0.1	0.33	0.35	0.15	-0.06	0.88	0.27	0.02	0	66
FIN	0.12	0.94	0.34	0.23	-0.99	0.95	0.01	0.12	0.02	66
FRA	0.11	0.75	0.27	0.14	-0.58	0.71	0.04	0.13	0.01	66
DEU	0.06	0.83	0.31	0.15	-1.62	1.14	0.02	0.1	0.02	53
ITA	0.03	1.55	0.43	0.12	-0.1	0.81	0.05	0.41	0	66
JPN	0.05	1.55	0.49	0.09	0.09	0.58	0	0.41	0	55
NLD	0.11	0.46	0.62	0.18	-1.31	0.66	0.01	0.02	0.03	66
NOR	0.12	0.52	0.45	0.15	-0.7	0.72	0.06	0.04	0.01	66
PRT	0.08	0.78	0.17	0.14	-0.34	0.65	0.03	0.38	0.01	66
ESP	0.09	0.62	0.24	0.22	-1.09	0.54	0	0.09	0.06	66
SWE	0.13	0.17	0.35	0.18	-0.42	0.84	0.23	0.01	0	66
CHE	0.07	0.34	0.3	0.14	-1.48	0.97	0.04	0.03	0.03	66
GBR	0.1	0.35	0.28	0.07	1.58	1.13	0.35	0.03	0.07	66
USA	0.07	0.8	0.2	0.17	-1.22	0.81	0.01	0.26	0.04	66
GME	0.09	0.69	0.42	0.15	-0.54	0.76	0.08	–	–	–
POLS	0.09	0.82	0.07	0.14	-0.3	0.33	0	0.14	0	1020

$\hat{\alpha}_x, \hat{\beta}_x$: Parameter estimates of equation (1), $\hat{\sigma}_{\beta_x}$: standard deviation of $\hat{\beta}_x$, $P_{\beta_H=\beta_E}$: p-value of the test $H_0 : \beta_H = \beta_E$ against $\beta_H \neq \beta_E$, R^2_x: coefficients of determination, T: Number of data points. $\hat{\sigma}_{\beta_x}$ are heteroskedasticity and autocorrelation consistent by allying the Newey-West estimator (Lags $= (4T/100)^{2/9}$) for OLS and POLS and consistent for weakly cross-correlated estimators $\hat{\theta}_i$ for GME.

4 Hedging in the medium run

4.1 Estimation strategy

The five and ten years moving averages of the return rates and the inflation rate are used to examine their relationship in the medium run. This approach follows Boudoukh and Richardson (1993). In a nutshell the model reads

$$\frac{1}{M}\sum_{\tau=1}^{M} r_{ixt+\tau} = \alpha_{ix} + \beta_{ix}\frac{1}{M}\sum_{\tau=1}^{M}\pi_{it+\tau} + e_{ixt+1}, \ \ldots, \ M \in \{5, 10\}. \tag{2}$$

The parameter estimation and inference is identical to the procedure in the short-run section.

4.2 Results

Table 6 and 7 present the key figures of Table 4 for equation (2). Table 6 for a 5-years moving average and 7 for a 10-years moving average of the *full* sample.

Concerning the point estimates of the 5-years return-inflation relation ($\hat{\beta}_x$) of both re-

Table 6: Hedging within 5 years

	$\hat{\alpha}_H$	$\hat{\beta}_H$	$\hat{\sigma}_{\beta_H}$	$\hat{\alpha}_E$	$\hat{\beta}_E$	$\hat{\sigma}_{\beta_E}$	$P_{\beta_H=\beta_E}$	R^2_H	R^2_E	T
AUS	0.05	1.46	0.24	0.11	0.12	0.3	0	0.6	0.01	109
BEL	0.11	0.19	0.1	0.09	0.43	0.22	0.18	0.12	0.16	104
DNK	0.1	0.62	0.09	0.07	0.98	0.22	0.26	0.28	0.26	134
FIN	0.11	0.81	0.33	0.19	-0.17	0.45	0.02	0.13	0	78
FRA	0.1	0.45	0.08	0.09	-0.05	0.17	0	0.27	0	139
DEU	0.08	0.46	0.25	0.07	0.91	0.58	0.36	0.06	0.07	97
ITA	0.03	1.39	0.16	0.1	0.31	0.47	0.03	0.72	0.02	70
JPN	0.04	1.48	0.28	0.05	0.88	0.39	0.03	0.55	0.12	59
NLD	0.07	1.22	0.18	0.08	0.63	0.42	0.08	0.37	0.04	110
NOR	0.1	0.51	0.12	0.08	0.38	0.25	0.2	0.26	0.05	129
PRT	0.07	0.88	0.16	0.11	0.15	0.59	0.07	0.66	0	62
ESP	0.08	0.57	0.1	0.13	-0.09	0.3	0.02	0.25	0	109
SWE	0.1	0.35	0.11	0.1	0.31	0.43	0.33	0.12	0.02	127
CHE	0.07	0.23	0.1	0.09	-0.29	0.29	0.04	0.06	0.02	108
GBR	0.06	0.82	0.16	0.09	0.65	0.34	0.24	0.36	0.13	103
USA	0.06	0.9	0.21	0.11	0.08	0.35	0	0.43	0	119
GME	0.08	0.77	0.41	0.1	0.33	0.38	0.16	–	–	–
POLS	0.09	0.59	0.1	0.1	0.26	0.17	0.02	0.27	0.02	1657

$\hat{\alpha}_x, \hat{\beta}_x$: Parameter estimates of equation (2), $\hat{\sigma}_{\beta_x}$: standard deviation of $\hat{\beta}_x$, $P_{\beta_H=\beta_E}$: p-value of the test $H_0 : \beta_H = \beta_E$ against $\beta_H \neq \beta_E$, R^2_x: coefficients of determination, T: Number of data points. $\hat{\sigma}_{\beta_x}$ are heteroskedasticity and autocorrelation consistent by allying the Newey-West estimator (Lags $= (4T/100)^{2/9}$) for OLS and POLS and consistent for weakly cross-correlated estimators $\hat{\theta}_i$ for GME.

Table 7: Hedging within 10 years

	$\hat{\alpha}_H$	$\hat{\beta}_H$	$\hat{\sigma}_{\beta_H}$	$\hat{\alpha}_E$	$\hat{\beta}_E$	$\hat{\sigma}_{\beta_E}$	$P_{\beta_H=\beta_E}$	R^2_H	R^2_E	T
AUS	0.05	1.38	0.13	0.11	0.38	0.22	0	0.73	0.09	104
BEL	0.1	0.32	0.1	0.1	0.28	0.16	0.29	0.26	0.09	94
DNK	0.09	0.73	0.09	0.07	1.05	0.15	0.24	0.45	0.44	129
FIN	0.09	1.23	0.3	0.19	-0.12	0.47	0	0.3	0	66
FRA	0.09	0.55	0.06	0.08	0.11	0.11	0	0.36	0.02	134
DEU	0.08	-0.17	0.22	0.08	0.6	0.41	0.26	0.01	0.07	82
ITA	0.05	1.29	0.15	0.09	0.44	0.46	0.06	0.82	0.04	60
JPN	0.03	1.87	0.21	0.04	1.45	0.26	0.02	0.77	0.43	49
NLD	0.07	1.27	0.16	0.09	0.59	0.35	0.03	0.47	0.05	105
NOR	0.09	0.62	0.12	0.07	0.42	0.24	0.12	0.35	0.07	124
PRT	0.08	0.9	0.09	0.09	0.39	0.41	0.07	0.83	0.07	57
ESP	0.09	0.58	0.11	0.12	0.01	0.26	0.01	0.35	0	104
SWE	0.1	0.5	0.13	0.09	0.63	0.41	0.38	0.25	0.08	122
CHE	0.07	0.26	0.09	0.1	-0.37	0.29	0.01	0.1	0.04	103
GBR	0.06	1.01	0.14	0.08	0.99	0.26	0.33	0.57	0.32	93
USA	0.06	0.99	0.14	0.11	0.05	0.22	0	0.62	0	114
GME	0.08	0.83	0.49	0.09	0.43	0.45	0.18	–	–	–
POLS	0.08	0.72	0.07	0.09	0.34	0.15	0	0.42	0.06	1540

$\hat{\alpha}_x, \hat{\beta}_x$: Parameter estimates of equation (2), $\hat{\sigma}_{\beta_x}$: standard deviation of $\hat{\beta}_x$, $P_{\beta_H=\beta_E}$: p-value of the test $H_0 : \beta_H = \beta_E$ against $\beta_H \neq \beta_E$, R^2_x: coefficients of determination, T: Number of data points. $\hat{\sigma}_{\beta_x}$ are heteroskedasticity and autocorrelation consistent by allying the Newey-West estimator (Lags $= (4T/100)^{2/9}$) for OLS and POLS and consistent for weakly cross-correlated estimators $\hat{\theta}_i$ for GME.

turn rates increase in comparison to the within one year relation. Based on interval inference ($\hat{\beta}_x \pm 2\hat{\sigma}_{\beta_x}$) and the hypothesis testing ($H_0 : \beta_H = \beta_E$), the results are similar to the short-run inference. In relation to the short run, the 5-years moving average coefficient of determination of the return on housing equation (R^2_H) doubles in the POLS estimation and increase as well in the individual country OLS estimates, which does not hold for the R-squared of the return on equity regressions.

Concerning the point estimates of the 10-years return-inflation relation ($\hat{\beta}_x$) of both return rates increase once again. Similarly, in the 5-years-within one year comparison, the results based on interval inference and hypothesis testing are alike, except for the equity $\hat{\beta}_E \pm 2\hat{\sigma}_{\beta_E}$ interval, which does not include the zero anymore in the POLS estimation. The coefficient of determination increases to 0.47 in the return on housing POLS regression and remains low in the regression of the return on equity. The R-squared of the return on housing regression is greater 0.7 in Australia, Italy, Japan, and Portugal. Over the 10-years horizon, we can observe the return rate of housing in Germany as an outlier with a negative point estimation for the inflation relationship.

Table 8 and 9 present the previous information for the *post-war* sample. For both time horizons the POLS estimator of the return on housing-inflation relation is near one (0.92 for a 5-years moving average and 0.97 for a 10-years moving average), and the $\hat{\beta}_H \pm 2\hat{\sigma}_{\beta_H}$ includes the one. Similar to the within one year relation, the within 5-years return on equity-inflation relation POLS point estimator and the point estimates on average are smaller in the in the *post-war* sample in comparison to the *full* sample. This does not apply to the 10-year horizon. Albeit, the *post-war* 10-year the POLS $\hat{\beta}_E \pm 2\hat{\sigma}_{\beta_E}$ reincludes the zero. Over the 5- and 10-years horizon, the return on housing-inflation relation in Belgium is an outlier with a negative point estimate and over the 5-years horizon even over the whole $\hat{\beta}_H \pm 2\hat{\sigma}_{\beta_H}$ interval.

To summarize the medium run, the point estimates of the return-inflation relation increase with a longer time horizon. Further, for the *post-war* sample, we cannot reject the hypothesis that housing is a perfect hedge against inflation. The hypothesis that equity is not a hedge against inflation could only be rejected for the 10-years horizon in the *full* sample. In many countries and in the POLS estimation in both samples, we could reject the hypothesis that $\beta_H = \beta_B$. Inflation accounts for a large fraction of the variation of the return on housing. E.g. the R^2_H is 0.47 in the *post-war* 10-years moving average POLS regression.

Table 8: Hedging within 5 years (post 1950)

	$\hat{\alpha}_H$	$\hat{\beta}_H$	$\hat{\sigma}_{\beta_H}$	$\hat{\alpha}_E$	$\hat{\beta}_E$	$\hat{\sigma}_{\beta_E}$	$P_{\beta_H=\beta_E}$	R_H^2	R_E^2	T
AUS	0.07	1.01	0.17	0.11	0.4	0.43	0.1	0.49	0.04	61
BEL	0.13	-0.62	0.28	0.08	1.88	1.12	0.12	0.13	0.11	45
DNK	0.1	0.54	0.3	0.1	0.93	0.6	0.38	0.09	0.1	61
FIN	0.12	0.85	0.28	0.21	-0.7	0.82	0.02	0.2	0.03	61
FRA	0.11	0.84	0.35	0.11	0.03	0.51	0.1	0.12	0	61
DEU	0.05	0.99	0.3	0.13	-1.05	0.85	0.01	0.19	0.04	48
ITA	0.05	1.31	0.19	0.1	0.33	0.59	0.08	0.68	0.01	61
JPN	0.04	1.73	0.43	0.04	1.21	0.44	0.06	0.6	0.18	50
NLD	0.09	1.22	0.56	0.17	-1.01	0.54	0	0.13	0.05	61
NOR	0.11	0.78	0.25	0.12	0.16	0.81	0.15	0.21	0	61
PRT	0.07	0.88	0.16	0.11	0.15	0.59	0.07	0.66	0	61
ESP	0.09	0.67	0.22	0.21	-0.86	0.56	0	0.22	0.09	61
SWE	0.13	0.22	0.28	0.13	0.64	0.74	0.38	0.02	0.04	61
CHE	0.07	0.42	0.25	0.13	-1.04	0.72	0.05	0.06	0.05	61
GBR	0.08	0.75	0.22	0.09	1.29	0.31	0.32	0.23	0.32	61
USA	0.05	1.12	0.17	0.14	-0.6	0.49	0	0.53	0.03	61
GME	0.09	0.79	0.51	0.12	0.11	0.9	0.22	–	–	–
POLS	0.08	0.92	0.07	0.12	0.21	0.34	0.01	0.32	0.01	936

$\hat{\alpha}_x, \hat{\beta}_x$: Parameter estimates of equation (2), $\hat{\sigma}_{\beta_x}$: standard deviation of $\hat{\beta}_x$, $P_{\beta_H=\beta_E}$: p-value of the test $H_0 : \beta_H = \beta_E$ against $\beta_H \neq \beta_E$, R_x^2: coefficients of determination, T: Number of data points. $\hat{\sigma}_{\beta_x}$ are heteroskedasticity and autocorrelation consistent by allying the Newey-West estimator (Lags $= (4T/100)^{2/9}$) for OLS and POLS and consistent for weakly cross-correlated estimators $\hat{\theta}_i$ for GME.

Table 9: Hedging within 10 years (post 1950)

	$\hat{\alpha}_H$	$\hat{\beta}_H$	$\hat{\sigma}_{\beta_H}$	$\hat{\alpha}_E$	$\hat{\beta}_E$	$\hat{\sigma}_{\beta_E}$	$P_{\beta_H=\beta_E}$	R_H^2	R_E^2	T
AUS	0.08	0.91	0.09	0.1	0.64	0.3	0.18	0.68	0.19	56
BEL	0.12	-0.17	0.24	0.05	3.47	0.55	0	0.02	0.59	35
DNK	0.1	0.54	0.19	0.1	0.92	0.28	0.35	0.18	0.25	56
FIN	0.12	0.98	0.19	0.2	-0.34	0.56	0.01	0.41	0.02	56
FRA	0.11	0.85	0.28	0.1	0.07	0.43	0.09	0.15	0	56
DEU	0.03	1.43	0.26	0.14	-1.05	0.7	0	0.51	0.08	43
ITA	0.05	1.25	0.15	0.09	0.45	0.47	0.08	0.83	0.04	56
JPN	0.02	1.97	0.26	0.04	1.6	0.26	0.03	0.79	0.48	45
NLD	0.09	1.28	0.49	0.17	-1.05	0.53	0	0.24	0.1	56
NOR	0.11	0.76	0.19	0.12	0.15	0.55	0.09	0.38	0	56
PRT	0.08	0.9	0.09	0.1	0.38	0.41	0.06	0.83	0.06	56
ESP	0.1	0.66	0.17	0.19	-0.54	0.42	0	0.43	0.08	56
SWE	0.13	0.24	0.13	0.12	0.9	0.48	0.3	0.12	0.15	56
CHE	0.06	0.56	0.2	0.13	-0.83	0.62	0.04	0.15	0.07	56
GBR	0.08	0.87	0.14	0.08	1.38	0.25	0.23	0.54	0.56	56
USA	0.06	1.08	0.1	0.13	-0.37	0.41	0	0.74	0.02	56
GME	0.08	0.88	0.48	0.12	0.36	1.13	0.26	–	–	–
POLS	0.08	0.97	0.06	0.11	0.4	0.25	0.01	0.47	0.04	851

$\hat{\alpha}_x, \hat{\beta}_x$: Parameter estimates of equation (2), $\hat{\sigma}_{\beta_x}$: standard deviation of $\hat{\beta}_x$, $P_{\beta_H=\beta_E}$: p-value of the test $H_0 : \beta_H = \beta_E$ against $\beta_H \neq \beta_E$, R_x^2: coefficients of determination, T: Number of data points. $\hat{\sigma}_{\beta_x}$ are heteroskedasticity and autocorrelation consistent by allying the Newey-West estimator (Lags $= (4T/100)^{2/9}$) for OLS and POLS and consistent for weakly cross-correlated estimators $\hat{\theta}_i$ for GME.

5 Hedging in the long run

5.1 Estimation strategy

The procedure for the long run differs from the short and medium one. The focus is on testing for cointegration. Therefore, I first verified above that the HPIs, EPIs ($PI_{ix}, x \in \{H, E\}, i \in \{\text{ISO}\}$), and the CPIs ($CPI_i$) are each individually integrated of first order ($I(1)$). I apply two procedures to the probably integrated time-series. In the first procedure the cointegration relationship is unity by assumption, in the second one, the magnitude of the relationship has to be estimated. Figure 1 qualifies for three specifications i) a one-by-one relationship with trend, ii) an excessive relationship without trend, and iii) an arbitrary relationship with trend.

Assuming a one-by-one relationship, I follow Hamilton (1994, Chapter 19.2) and execute an Augmented Dicky-Fuller (ADF) test using the following model:

$$\ln(\tfrac{PI_{ixt}}{CPI_{it}}) = \alpha_{ix} + \delta_{ix} t + \phi_{ix} \ln(\tfrac{PI_{ixt-1}}{CP_{it-1}}) + \sum_{j=1}^{L_i} \beta_{jix} \Delta \ln(\tfrac{PI_{ixt-j}}{CPI_{it-j}}) + e_{ixt}, ..., t = 1, ..., T_i, \tag{3}$$

where Δ is the difference operator, δ_{ix} a deterministic trend, and ϕ_{ix} the AR(1) coefficient.

To estimate the magnitude of the relationship, I execute an Engle-Granger cointegration test using the following model:

$$\ln(PI_{ixt}) = \alpha_{ix} + \bar{\delta}_{ix} t + \beta_{ix} \ln(CPI_{ix}) + e_{ixt}, \; \bar{\delta}_{ix} \in \{0, \delta_{ix}\}, \tag{4}$$

$$e_{ixt} = \phi_{ix} e_{ixt-1} + \sum_{j=1}^{L_i} \beta_{jix} \Delta e_{ixt-j} + u_{ixt}. \tag{5}$$

Both approaches will be to test the null hypothesis that there is no cointegration, $H_0 : \phi_{ix} = 1$ under the alternative hypothesis $|\phi_{ix}| < 1$. I report the p-values from $t_{1i} = (\hat{\phi}_{ix} - 1)/\hat{\sigma}_{\phi_{ix}}$ and $t_{2i} = T_i(\hat{\phi}_{ix} - 1)$ ADF statistics.

The panel structure for parameter estimation is used by only applying the GME, as the POLS estimator is inconsistent in the dynamic case (see Pesaran and Smith, 1995). The panel cointegration tests also applies to the null hypothesis that there is no cointegration ($H_0 : \phi_{ix} = 1$ for all i). There are two alternative hypotheses, one for individual (group mean) AR coefficients, ($H_1 : |\phi_{ix}| < 1$ for all i) and one for a common (pooled) AR coefficient ($H_1 : |\phi_{ix}| = |\phi_x| < 1$ for all i). The known-by-assumption relationship tests are

Table 10: Perfect Hedge

	Housing					Equity				
	t_1	t_2	$\hat{\delta}$	$\hat{\phi}$	L	t_1	t_2	$\hat{\delta}$	$\hat{\phi}$	L
AUS	0.36	0.49	5.97	0.92	0	0.12	0.11	5.93	0.85	0
BEL	–	–	–	–	–	0.79	0.73	2.54	0.95	0
DNK	0.84	0.71	7.9	0.97	1	0.64	0.46	5.17	0.93	0
FIN	0.03	0.01	7.61	0.93	7	–	–	–	–	–
FRA	0.73	0.74	5.74	0.98	1	0.65	0.67	-1.2	0.96	1
DEU	–	–	–	–	–	0.23	0.16	3.21	0.89	0
ITA	0.47	0.69	2.48	0.95	1	0.34	0.3	1.42	0.86	0
JPN	–	–	–	–	–	0.42	0.44	3.04	0.92	1
NLD	0.22	0.44	7.41	0.94	2	0.53	0.61	5.08	0.93	0
NOR	0.95	0.95	7.03	0.98	0	0.58	0.5	2.98	0.93	0
PRT	–	–	–	–	–	–	–	–	–	–
ESP	0.38	0.38	4.95	0.9	0	0.15	0.08	3.41	0.9	1
SWE	–	–	–	–	–	0.93	0.92	5.18	0.98	0
CHE	0.03	0.01	5.12	0.88	1	0.28	0.27	4.79	0.89	0
GBR	0.65	0.71	4.83	0.96	1	0.41	0.44	5.05	0.91	0
USA	0.06	0.06	5.39	0.84	0	0.08	0.06	6.48	0.84	0
GME	0.30	0.25	5.86	0.93		0.20	0.66	3.79	0.91	

t_1 for ISO: Left-hand tail p-value of $(\hat{\phi}_{ix} - 1)/\hat{\sigma}_{\phi_{ix}}$, for GME: p-value from the Im, Pesaran, and Shin test, t_2 for ISO: Left-hand tail p-value of $T(\hat{\phi}_{ix} - 1)$, for GME: p-value from the Levin, Lin, and Chu. Variables with hats are estimates from equation (3). The lag L selection rests on Bayesian information criterion with maximal 12 lags.

the Im, Pesaran, and Shin and the Levin, Lin, and Chu test, respectively, Pedroni's (2004) Group and Panel ADF-test apply to test the cointegration of the estimated relationship.[6]

5.2 Results

Table 10 presents for the *full* sample p-values of the hypothesis that there is no one-by-one cointegration between nominal return rates and inflation, and additionally estimates of the key parameters of equation (3). Table 11 and 12 report the same for equation 4 and 5 without and with trend, respectively.

The results in Table 10 show, in the case of perfect hedges, we can only reject the hypothesis that there is no cointegration for Finland and Switzerland at the 5% significance level and for the U.S. at the 10% level and all of this only for housing. Once we drop the assumption of a perfect hedge, we get further insights. First, regarding the GME for the HPI-CPI relationship without trend (Table 11), we can reject the hypothesis for the wohle sample that there is no cointegration and housing provides an excessive hedge. If we assume a trend (Table 12), we can reject the hypothesis of no cointegration between

[6]According to Pedroni (2019) the GME is far more common.

Table 11: Non-perfect Hedge without trend component

	Housing					Equity				
	t_1	t_2	$\hat{\beta}$	$\hat{\phi}$	L	t_1	t_2	$\hat{\beta}$	$\hat{\phi}$	L
AUS	0.59	0.64	2.36	0.94	0	0.47	0.67	2.29	0.95	0
BEL	–	–	–	–	–	0.87	0.8	1.41	0.97	0
DNK	0.31	0.56	3.03	0.97	1	0.18	0.39	2.36	0.93	0
FIN	0.46	0.33	2.02	0.96	2	–	–	–	–	–
FRA	0.42	0.41	1.76	0.98	1	0.56	0.54	0.78	0.96	1
DEU	–	–	–	–	–	0.83	0.78	1.06	0.97	0
ITA	0.69	0.72	1.14	0.97	1	0.39	0.35	1.1	0.88	0
JPN	–	–	–	–	–	0.63	0.6	1.09	0.95	1
NLD	0.21	0.14	3.14	0.93	1	0.53	0.51	2.48	0.93	0
NOR	0.12	0.13	2.84	0.94	1	0.49	0.49	1.77	0.94	0
PRT	–	–	–	–	–	–	–	–	–	–
ESP	0.38	0.37	1.7	0.93	1	0.21	0.12	1.47	0.92	1
SWE	–	–	–	–	–	0.16	0.07	2.42	0.91	1
CHE	0.07	0.02	2.96	0.93	1	0.16	0.08	2.84	0.9	1
GBR	0.08	0.02	2.1	0.91	1	0.33	0.3	2.14	0.9	0
USA	0.12	0.51	2.76	0.93	0	0.33	0.46	3.1	0.93	0
GME	0.02	0.03	2.35	0.95		0.17	0.10	1.88	0.93	

t_1 for ISO: Left-hand tail p-value of $(\hat{\phi}_{ix}-1)/\hat{\sigma}_{\phi_{ix}}$, for GME: p-value from Pedroni's (2004) Group ADF-test, t_2 for ISO: Left-hand tail p-value of $T(\hat{\phi}_{ix}-1)$, for GME: p-value from the Pedroni's (2004) Panel ADF-test. Variables with hats are estimates from equation (4) and (5). The lag L selection rests on Bayesian information criterion with maximal 12 lags.

Table 12: Non-perfect Hedge with trend component

	Housing						Equity					
	t_1	t_2	$\hat{\delta}$	$\hat{\beta}$	$\hat{\phi}$	L	t_1	t_2	$\hat{\delta}$	$\hat{\beta}$	$\hat{\phi}$	L
AUS	0.13	0.11	3.74	1.52	0.81	0	0.03	0.02	8.62	0.37	0.75	0
BEL	–	–	–	–	–	–	0.08	0.04	8.41	-0.13	0.84	1
DNK	0.9	0.74	9.27	0.61	0.97	1	0.66	0.52	4.41	1.21	0.91	0
FIN	0.77	0.75	12	0.36	0.96	1	–	–	–	–	–	–
FRA	0.86	0.87	5.64	1.01	0.98	1	0.64	0.62	5.63	0.03	0.93	0
DEU	–	–	–	–	–	–	0	0	5.45	0.92	0.7	0
ITA	0.55	0.66	11.24	0.07	0.94	1	0.41	0.42	4.5	0.67	0.84	0
JPN	–	–	–	–	–	–	0.83	0.79	7.68	0.48	0.93	1
NLD	0.26	0.25	4.94	1.74	0.9	2	0.69	0.72	2.54	1.76	0.92	0
NOR	0.8	0.71	5.88	1.32	0.95	1	0.76	0.69	3.42	0.88	0.93	0
PRT	–	–	–	–	–	–	–	–	–	–	–	–
ESP	0.55	0.58	5.15	0.97	0.9	0	0.23	0.17	6.58	0.53	0.89	1
SWE	–	–	–	–	–	–	0.53	0.39	1.41	2.06	0.92	1
CHE	0.08	0.03	6.42	0.47	0.87	1	0.42	0.47	6.12	0.45	0.88	0
GBR	0.34	0.18	1.95	1.67	0.92	1	0.49	0.49	2.88	1.5	0.89	0
USA	0.07	0.09	5.08	1.11	0.82	0	0.18	0.16	6.87	0.87	0.84	0
GME	0.21	0.34	6.48	0.99	0.91		0.03	0.00	5.32	0.83	0.87	

t_1 for ISO: Left-hand tail p-value of $(\hat{\phi}_{ix}-1)/\hat{\sigma}_{\phi_{ix}}$, for GME: p-value from Pedroni's (2004) Group ADF-test, t_2 for ISO: Left-hand tail p-value of $T(\hat{\phi}_{ix}-1)$, for GME: p-value from the Pedroni's (2004) Panel ADF-test. Variables with hats are estimates from equation (4) and (5). The lag L selection rests on Bayesian information criterion with maximal 12 lags.

the HPI and CPI for Switzerland and USA at the 10% level. Housing hedges partially in Switzerland and excessively in the U.S. Concerning the EPI-CPI relationship, we can reject the no cointegration hypothesis for Australia and Germany as well as for the whole panel at the 5% level with the trend specification. If the CPI increases by 1%, the EPI increase by 0.83% on average ceteris paribus in the whole panel, by 0.37% in Australia and by 0.92% in Germany. At the 10% level we can reject the hypothesis also for Belgium, but with a negative estimator.

Table 13, 14, and 15 present the results for the *post-war* sample. Assuming perfect hedges (Table 13), the hypothesis of no cointegration between HPI and CPI as well as between EPI and CPI can be rejected at the 5% level for the whole panel. On the individual country basis solely, one can reject the HPI-CPI relationship for Australia, the Netherlands, and the United Kingdom at the 5% level, and for France, Norway, Spain, and the U.S at the 10% level. For the relationship between EPI-CPI, we can reject the hypothesis of no cointegration at the 10% level only for Australia. Dropping the assumption of perfect hedging and estimating equation (4) without a trend (Table 14), shows we can reject the no cointegration hypothesis for the Japanese EPI-CPI relation at the 5% level, where equity hedges excessively. The estimates where equation (4) includes a trend (Table 15) show, we can reject the hypothesis of no cointegration between HPI and CPI at the 5% level for the whole panel, Australia, and the United Kingdom and additionally at the 10% level for The Netherlands. The average elasticity is 0.92 and thus near a perfect hedge. The hypothesis could also be rejected for the whole panel for the EPI-CPI relation at the 5% level and for Australia and Japan at the 10% level. Again equity is an excessive hedge for Japan. The average elasticity of the EPI-CPI relation is small (0.19), because the estimates include several negative relationships.

The summary of the long-time horizon reads as follows: We can reject the hypothesis of no cointegrated relationships between the performance indices and the CPI in both samples at the 5% level in general. In the *full* sample, the no cointegration hypothesis can only be rejected assuming imperfect hedges, where housing is an excessive and equity a partial hedge. In the *post-war* sample, we can reject the no cointegration hypothesis for both performance indices assuming perfect hedges. Without this assumption and estimating the magnitude of the nominal return-inflation relation it turns out, housing is closer to a perfect hedge.

Table 13: Perfect Hedge (post 1950)

	Housing					Equity				
	t_1	t_2	$\hat{\delta}$	$\hat{\phi}$	L	t_1	t_2	$\hat{\delta}$	$\hat{\phi}$	L
AUS	0	0	6.75	0.64	1	0.06	0.05	5.72	0.7	0
BEL	–	–	–	–	–	0.57	0.58	5.39	0.87	0
DNK	0.36	0.43	6.29	0.91	1	0.15	0.1	7.01	0.74	0
FIN	0.64	0.65	9.56	0.91	4	–	–	–	–	–
FRA	0.01	0.6	8.3	0.96	1	0.86	0.87	2.54	0.94	0
DEU	–	–	–	–	–	0.01	0.08	6.16	0.73	0
ITA	0.89	0.75	5.78	0.91	0	0.64	0.69	1.84	0.9	0
JPN	–	–	–	–	–	0.19	0.65	5.44	0.89	0
NLD	0.03	0.01	8.3	0.88	1	0.61	0.62	7.07	0.88	0
NOR	0.1	0	8.79	0.79	5	0.56	0.61	4.23	0.88	0
PRT	–	–	–	–	–	–	–	–	–	–
ESP	0.07	0	5.74	0.79	2	0.43	0.34	4.53	0.89	1
SWE	0.91	0.81	8.31	0.95	5	0.31	0.31	8.39	0.81	0
CHE	0.56	0.29	4.9	0.92	1	0.34	0.32	5.32	0.82	0
GBR	0	0	6.71	0.75	1	0.2	0.15	6.83	0.77	0
USA	0.06	0.04	5.59	0.88	3	0.45	0.52	6.18	0.86	0
GME	0.00	0.00	7.09	0.86		0.04	0.01	5.48	0.83	

t_1 for ISO: Left-hand tail p-value of $(\hat{\phi}_{ix}-1)/\hat{\sigma}_{\phi_{ix}}$, for GME: p-value from the Im, Pesaran, and Shin test, t_2 for ISO: Left-hand tail p-value of $T(\hat{\phi}_{ix}-1)$, for GME: p-value from the Levin, Lin, and Chu. Variables with hats are estimates from equation (3). The lag L selection rests on Bayesian information criterion with maximal 12 lags.

Table 14: Non-perfect Hedge without trend component (post 1950)

	Housing					Equity				
	t_1	t_2	$\hat{\beta}$	$\hat{\phi}$	L	t_1	t_2	$\hat{\beta}$	$\hat{\phi}$	L
AUS	0.89	0.88	2.21	0.97	2	0.47	0.46	2	0.86	0
BEL	–	–	–	–	–	0.76	0.72	2.32	0.92	0
DNK	0.45	0.49	2.17	0.94	1	0.91	0.83	2.28	0.94	0
FIN	0.86	0.76	2.67	0.97	4	–	–	–	–	–
FRA	0.3	0.16	2.59	0.96	3	0.88	0.87	1.39	0.95	0
DEU	–	–	–	–	–	0.04	0.19	3.07	0.8	0
ITA	0.29	0.14	1.83	0.9	2	0.61	0.65	1.22	0.91	0
JPN	–	–	–	–	–	0.02	0.02	2.53	0.78	1
NLD	0.64	0.59	3.16	0.95	2	0.78	0.78	2.78	0.93	0
NOR	0.68	0.07	2.66	0.96	5	0.77	0.74	1.75	0.92	0
PRT	–	–	–	–	–	–	–	–	–	–
ESP	0.16	0.05	1.72	0.89	2	0.52	0.45	1.51	0.92	1
SWE	0.96	0.92	2.51	0.99	5	0.86	0.79	2.54	0.93	0
CHE	0.95	0.84	2.59	0.98	1	0.77	0.72	2.68	0.92	0
GBR	0.74	0.66	2.15	0.95	2	0.58	0.58	2.17	0.89	0
USA	0.92	0.84	2.37	0.98	2	0.6	0.68	2.49	0.91	0
GME	0.92	0.63	2.39	0.95		0.87	0.49	2.20	0.90	

t_1 for ISO: Left-hand tail p-value of $(\hat{\phi}_{ix}-1)/\hat{\sigma}_{\phi_{ix}}$, for GME: p-value from Pedroni's (2004) Group ADF-test, t_2 for ISO: Left-hand tail p-value of $T(\hat{\phi}_{ix}-1)$, for GME: p-value from the Pedroni's (2004) Panel ADF-test. Variables with hats are estimates from equation (4) and (5). The lag L selection rests on Bayesian information criterion with maximal 12 lags.

Table 15: Non-perfect Hedge with trend component (post 1950)

	Housing						Equity					
	t_1	t_2	$\hat{\delta}$	$\hat{\beta}$	$\hat{\phi}$	L	t_1	t_2	$\hat{\delta}$	$\hat{\beta}$	$\hat{\phi}$	L
AUS	0.01	0	7.35	0.89	0.63	1	0.07	0.07	8.93	0.4	0.65	0
BEL	–	–	–	–	–	–	0.69	0.71	8.53	0.17	0.86	0
DNK	0.6	0.61	6.79	0.9	0.92	1	0.12	0.11	9.5	0.51	0.68	0
FIN	0.82	0.71	8.34	1.22	0.91	4	–	–	–	–	–	–
FRA	0.07	0.43	6.47	1.37	0.95	1	0.83	0.85	10.1	-0.52	0.9	0
DEU	–	–	–	–	–	–	0.02	0.14	10.46	-0.52	0.7	0
ITA	0.8	0.69	4.49	1.19	0.86	0	0.77	0.79	6.88	0.25	0.88	0
JPN	–	–	–	–	–	–	0.06	0.09	0.69	2.36	0.78	1
NLD	0.06	0.01	7.69	1.17	0.88	1	0.78	0.74	11.76	-0.27	0.87	0
NOR	0.02	1	10.61	0.64	0.66	5	0.53	0.61	10.95	-0.34	0.83	0
PRT	–	–	–	–	–	–	–	–	–	–	–	–
ESP	0.13	0	6.02	0.96	0.78	2	0.5	0.3	14.05	-0.26	0.84	1
SWE	0.4	0	11.65	0.34	0.78	5	0.46	0.5	10.17	0.65	0.81	0
CHE	0.42	0.25	6.36	0.49	0.88	1	0.28	0.24	9.78	-0.55	0.74	0
GBR	0.01	0	7.06	0.94	0.75	1	0.38	0.34	7.73	0.84	0.77	0
USA	0.19	0.08	5.7	0.97	0.89	1	0.62	0.66	10.24	-0.03	0.85	0
GME	0.00	0.02	7.38	0.92	0.83		0.05	0.03	9.27	0.19	0.80	

t_1 for ISO: Left-hand tail p-value of $(\hat{\phi}_{ix}-1)/\hat{\sigma}_{\phi_{ix}}$, for GME: p-value from Pedroni's (2004) Group ADF-test, t_2 for ISO: Left-hand tail p-value of $T(\hat{\phi}_{ix}-1)$, for GME: p-value from the Pedroni's (2004) Panel ADF-test. Variables with hats are estimates from equation (4) and (5). The lag L selection rests on Bayesian information criterion with maximal 12 lags.

6 Dynamics

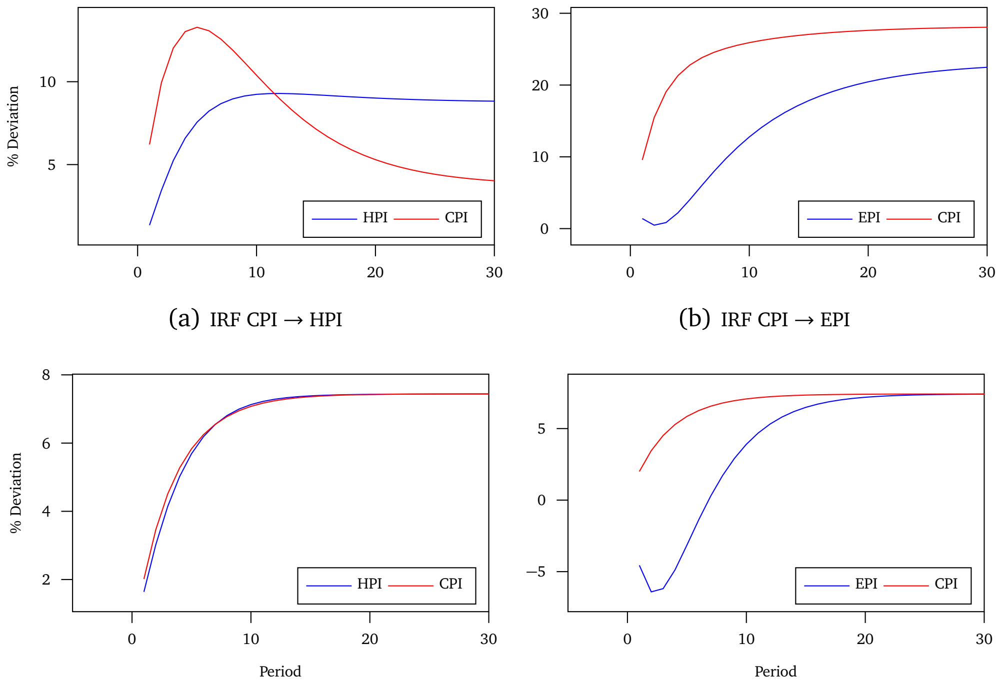
Up to this point, the results focus on the return-inflation relationship within different discrete time horizons, namely one year (short run), five and ten year (both medium run), as well as in the long run via cointegration testing. It turns out, the results depend on the time horizon. To illustrate this time-dependency and additionally the transmissions, Figure 3 plots orthogonal IRFs of a panel VECMs model with one lag.[7] In the *full* sample, the estimated country-specific long-run relationships for housing and equity from Table 11 and 12 are used, respectively, as the hypothesis of no one-by-one cointegration cannot be rejected for the whole panel. In the *post-war* period, the assumption of a perfect hedge holds for the whole panel. The short-run dynamics estimation is also country-specific in the first step. To use the panel structure, the GME applies, as Rebucci (2010) and Canova and Ciccarelli (2013) suggest.[8]

The IRF of the HPI and EPI to an inflation shock is plotted in panel (a) and (b) of Figure

[7]The *full* sample estimates exclude German data as the hyperinflation (1923) is an extreme outlier and thus would dominate the results.

[8]I am not aware of any suitable methodology for constructing confidence intervals for GME-VECM IRFs.

Figure 3: Orthogonalized IRFs of VECMs



(a) IRF CPI → HPI

(b) IRF CPI → EPI

(c) IRF CPI → HPI (post 1950)

(d) IRF CPI → EPI (post 1950)

The *full* sample estimates exclude German data as the hyperinflation (1923) is an extreme outlier and thus would dominate the results.

3 for the *full* sample. The dynamics match the discrete time horizon estimates. Housing hedges in the short run partly and the HPI intersects the CPI approximately after 12 years. Equity is not a hedge against inflation shocks in the short run and the transition ends approximately after 25 years. Panel (c) and (d) of Figure 3 display the IRF of the HPI and EPI for the *post-war* period. Housing is a good hedge even in the short run and a perfect hedge within approximately 7 years. Equity tends to be a hazard in the short run, after 7 years the negative effect of the inflation shock vanishes, and within approximately 20 years equity is a perfect hedge against inflation shocks.

7 Robustness

The return on housing combines rental income and changes in house prices. Jordà et al. (2019) reports the former rely on the rent components of the cost of living of CPIs. This results potentially in a simultaneous causality bias in the short and medium term analysis, while the cointegration estimates are consistent, even in the case of simultaneous causality. Two approaches address the problem. The first subtracts out the rent component from the CPI (non-housing CPI), the latter subtracts out yields from the asset return (asset price indices).

7.1 Non-housing CPI:

The JST database enables to calculate an index of the change in nominal rents. This change can be interpreted as an equivalent to the housing costs component π_t^h of inflation. The non-housing inflation is determined by $\pi_t^{xh} = \frac{\pi_t - h\pi_t^h}{1-h}$, where h is the average weight of housing costs of the OECD.stats (2020) CPI of the respective country. The constructed data is not appropriate for cointegration testing, as the procedure is rough and blows up in the long run. However, as mentioned the cointegration estimators are consistent.

The estimates of the results can be found in the Appendix Tables 16-21. On average, the return on housing-inflation relations decreases by 0.10-0.15. The same holds for the POLS estimates, whose $\hat{\beta}_H \pm 2\hat{\sigma}_{\beta_H}$ intervals do not include the one anymore. Nevertheless, we must reject further the hypothesis of an equal return-inflation relationship of housing and equity at the 5% level. Hence, hedging against inflation is superior with housing even when the housing inflation component, which housing hedges perfectly by definition, is subtracted from the CPI. It is worth mentioning that the R^2 with respect to housing in the medium run remains high.

7.2 Asset price indices

The JST database includes percentage capital gains which is equivalent to percentage changes of asset prices. Note that the use of asset prices rules out simultaneous causality of housing costs and CPI from two perspectives. First, new house prices compose the costs of new land and construction, both are not included in the CPI. Second, asset prices are not a direct component of CPIs and rely fundamentally on claims on future rents and thus, also do not affect the contemporaneous CPI neither directly nor indirectly.

The reapplication of the executed procedures, yet with prices, leads to additional insights, which is why it is meaningful to perform cointegration analyses as well. First, a strand of literature uses only asset price indices for various reasons. Thus, the implementation provides a better comparability with these studies. Second, the JST database contains more data points for capital gains than for return rates. E.g. the number of data points for the estimation of the within one year relationship increase from 1769 to 1905, including Canadian data and the time of the German hyperinflation in total.

The necessary unit-root and stationarity tests can be found in Tables 36-39. The estimates of the results can be found in the Appendix Tables 22-33.

In the *full* sample, the within one year asset price inflation-inflation relationship decrease by 0.11 for housing and increase by 0.15 for equity in comparison to the return rates-inflation relation. Canadian house price-inflation relationship interval ($\hat{\beta}_H \pm 2\hat{\sigma}_{\beta_H}$) includes the one and the point estimator is greater one while the respective interval for the equity price-inflation relation includes also the zero and the point estimator amounts to 0.26. Concerning the data of Germany including the hyperinflation, the house price-inflation is marginal with 0.06, but still statistically significant.[9] The equity price-inflation relation for Germany including the hyperinflation amounts to 2. Including the data of the German hyperinflation increases also the POLS point estimator of the equity price-inflation relationship to 0.93, nevertheless the $\hat{\beta}_E \pm 2\hat{\sigma}_{\beta_E}$ interval includes the zero. The latter does not hold for the house price-inflation relation. The hypothesis of an equal relationship cannot be rejected.

In the medium run, the POLS estimate for the house price-inflation relationship increases, but is only larger than the equity price-inflation relation for the 10 year horizon. The relationships are statistically not different in the short and medium run for the whole sample.

With the exclusion of the German hyperinflation by considering the *post-war* period, the results become similar to the return rates-inflation relationships. For the whole panel in the short run, the house price-inflation relation is on average 0.73 and the equity price-inflation relation tends to be negative. Both relations increase within the medium run in comparison to the short run. Within both time horizons we can reject the hypothesis of equal relations applying the POLS estimator and the house price-inflation relationship is on average larger.

Concerning the cointegration tests, the results for house prices for the panel as a whole are similar to the total returns. House prices excessively hedge against inflation in the *full* sample, although in a lower magnitude in comparison to the HPI. In the *post-war* period, house prices are a perfect hedge. The dynamics are similar to total returns, visible in the IRF of Figure 3 panel (a) and (c). For the equity price-inflation relation, we cannot reject

[9] Knoll et al. (2017) describe the striking house price behavior by persistent rental controls, resulting in negative return rates.

the hypothesis of no cointegration for the *full* sample for the whole panel for no specification. In the *post-war* period we can reject the no cointegration hypothesis with an elasticity on average of 0.19. Unfortunately, we cannot test the cointegration relationship of house prices for Germany as the house price series fails the unit-root test (see Appendix Table 36). For the equity price index-CPI relationship in Germany, we can reject the hypothesis of no cointegration and estimate an elasticity of 0.9, similar to return rates. For Canada we can reject the hypothesis of no one-by-one cointegration relationship for the *full* sample for housing and equity and for housing in the *post-war* period, everything at the 5% level. Further, we can reject the hypothesis of no cointegration for the equity price-inflation relation for Canada at the 10% level if the magnitude is estimated. Albeit, elasticity of 0.1 is small.

8 Conclusion

As housing and equity are real assets or represent claims on them, theoretically they should keep pace with inflation and should offer an ex-post hedge against general price shocks. The present paper confronts this proposition with data from the JST Macrohistory Database and the study contributes thereby to the asset return-inflation literature. The database covers housing and equity return rates and CPIs for 16 countries from 1870 till 2015. The investigation differentiates between the *full* sample and the *post-war* period and considers each country individually and the panel as a whole. The assessment conducts for different time horizons, in fact the short and medium run (within one, five and ten years) and the long run (cointegration). IRFs of VECMs illustrate the transmissions.

Summarizing the results: Housing hedges against inflation at least partly in the short run. In the medium run the relationship is on average higher in comparison to the short run and housing is a perfect hedge in the *post-war* period. In the long run housing is an excessive hedge in the *full* sample and a perfect hedge in the *post-war* sample. The IRFs of the VECMs show that the transition to the new equilibrium takes about 10 years. Equity does not provide a hedge against inflation in the short run and in the *post-war* sample equity tends actually to be a hazard. Noteworthy, during the time of the hyperinflation in Germany equity return rates kept pace instantaneously with inflation. In the medium run, the relationship estimates increase on average in comparison to the short run and tends again to be smaller in the *post-war* period. However, the latter reverses in the long run, where equity hedges on average 83% against inflation in the *full* sample and perfectly in the *post-war* sample. The VECM IRFs of EPIs to an inflation shock visualizes the transition to the new equilibrium takes longer in comparison to HPIs, namely about 20 years. Based on POLS estimation, the hypothesis that equity and housing are equally good inflation hedges in the short- and medium run must be rejected at the 5% level. Thus, in the short- and medium run housing is a superior hedge against inflationin comparison to equity and a weak superior in the long run. These results are robust when addressing simultaneous causality concerns and, particularly with respect to equity, are in line with previous studies.

It is important to note that inflation accounts for a large fraction of the variation of the return on housing in the medium run. E.g. the coefficient of determination of the housing return-inflation relation is 0.47 in the *post-war* 10-years moving average POLS regression in comparison to 0.04, the coefficient of determination of the equity return-inflation relation.

Different characteristics between housing and equity, as e.g. the close spatial ties between housing operation and the respective currency area in contrast to the ability of equity to operate internationally, provides explanatory approaches for future studies to solve the 'short term stock-return inflation puzzle'.

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APPENDIX

Hedging Against Inflation: Housing vs. Equity

A Robustness

A.1 non-housing CPI

Table 16: Hedging within one year (non-housing CPI)

	$\hat{\alpha}_H$	$\hat{\beta}_H$	$\hat{\sigma}_{\beta_H}$	$\hat{\alpha}_E$	$\hat{\beta}_E$	$\hat{\sigma}_{\beta_E}$	$P_{\beta_H=\beta_E}$	R_H^2	R_E^2	T
AUS	0.07	1.06	0.34	0.12	-0.1	0.38	0.01	0.15	0	114
BEL	0.11	0.11	0.09	0.09	0.33	0.22	0.25	0.06	0.08	113
DNK	0.1	0.37	0.09	0.09	0.52	0.22	0.38	0.13	0.05	139
FIN	0.14	0.3	0.19	0.19	-0.54	0.36	0.02	0.02	0.02	91
FRA	0.11	0.26	0.09	0.09	-0.09	0.13	0.01	0.11	0	144
DEU	0.09	0.41	0.31	0.09	-0.3	0.95	0.15	0.02	0	110
ITA	0.05	0.98	0.25	0.12	-0.34	0.33	0	0.42	0.01	79
JPN	0.09	0.48	0.23	0.09	-0.02	0.23	0.05	0.11	0	68
NLD	0.09	0.69	0.18	0.09	0.49	0.49	0.25	0.15	0.02	115
NOR	0.1	0.3	0.09	0.08	0.23	0.19	0.27	0.07	0.01	134
PRT	0.08	0.72	0.16	0.15	-0.42	0.57	0.01	0.37	0.01	67
ESP	0.08	0.55	0.1	0.12	0.01	0.23	0.02	0.13	0	114
SWE	0.11	0.14	0.07	0.11	0.14	0.33	0.34	0.02	0	132
CHE	0.08	0.19	0.11	0.09	-0.18	0.21	0.08	0.04	0	113
GBR	0.08	0.44	0.15	0.1	0.33	0.48	0.3	0.09	0.01	112
USA	0.08	0.44	0.17	0.12	-0.36	0.33	0	0.09	0.01	124
GME	0.09	0.47	0.27	0.11	-0.02	0.32	0.13	–	–	–
POLS	0.1	0.34	0.07	0.1	0.1	0.15	0.05	0.09	0	1769

$\hat{\alpha}_x, \hat{\beta}_x$: Parameter estimates of equation (2), $\hat{\sigma}_{\beta_x}$: standard deviation of $\hat{\beta}_x$, $P_{\beta_H=\beta_E}$: p-value of the test $H_0: \beta_H = \beta_E$ against $\beta_H \neq \beta_E$, R_x^2: coefficients of determination, T: Number of data points. $\hat{\sigma}_{\beta_x}$ are heteroskedasticity and autocorrelation consistent by allying the Newey-West estimator (Lags $= (4T/100)^{2/9}$) for OLS and POLS and consistent for weakly cross-correlated estimators $\hat{\theta}_i$ for GME.

Table 17: Hedging within one year (post 1950, non-housing CPI)

	$\hat{\alpha}_H$	$\hat{\beta}_H$	$\hat{\sigma}_{\beta_H}$	$\hat{\alpha}_E$	$\hat{\beta}_E$	$\hat{\sigma}_{\beta_E}$	$P_{\beta_H=\beta_E}$	R^2_H	R^2_E	T
AUS	0.08	1.28	0.55	0.14	-0.28	0.54	0.02	0.13	0	66
BEL	0.11	0.11	0.56	0.14	-0.51	1.57	0.28	0	0	54
DNK	0.11	0.27	0.3	0.15	-0.11	0.7	0.25	0.02	0	66
FIN	0.15	0.5	0.26	0.22	-0.91	0.75	0.03	0.04	0.02	66
FRA	0.14	0.28	0.28	0.12	-0.29	0.66	0.18	0.02	0	66
DEU	0.07	0.54	0.27	0.15	-2.04	0.99	0.01	0.05	0.03	53
ITA	0.04	1.47	0.42	0.14	-0.32	0.8	0.03	0.39	0	66
JPN	0.07	1.14	0.37	0.09	-0.04	0.48	0	0.25	0	55
NLD	0.11	0.37	0.53	0.18	-1.44	0.68	0.01	0.01	0.04	66
NOR	0.12	0.46	0.44	0.15	-0.65	0.66	0.07	0.04	0.01	66
PRT	0.08	0.72	0.16	0.15	-0.39	0.59	0.02	0.37	0.01	66
ESP	0.1	0.5	0.22	0.21	-0.98	0.51	0.01	0.07	0.05	66
SWE	0.13	0.12	0.35	0.16	-0.02	0.69	0.31	0	0	66
CHE	0.07	0.4	0.27	0.14	-1.72	0.9	0.02	0.05	0.04	66
GBR	0.11	0.25	0.22	0.09	1.23	1.17	0.37	0.02	0.05	66
USA	0.08	0.57	0.18	0.16	-1.15	0.69	0.01	0.17	0.04	66
GME	0.1	0.56	0.39	0.15	-0.6	0.75	0.08	–	–	–
POLS	0.09	0.69	0.07	0.14	-0.34	0.32	0	0.11	0	1020

$\hat{\alpha}_x, \hat{\beta}_x$: Parameter estimates of equation (1), $\hat{\sigma}_{\beta_x}$: standard deviation of $\hat{\beta}_x$, $P_{\beta_H=\beta_E}$: p-value of the test $H_0 : \beta_H = \beta_E$ against $\beta_H \neq \beta_E$, R^2_x: coefficients of determination, T: Number of data points. $\hat{\sigma}_{\beta_x}$ are heteroskedasticity and autocorrelation consistent by allying the Newey-West estimator (Lags $= (4T/100)^{2/9}$) for OLS and POLS and consistent for weakly cross-correlated estimators $\hat{\theta}_i$ for GME.

Table 18: Hedging within 5 years (non-housing CPI)

	$\hat{\alpha}_H$	$\hat{\beta}_H$	$\hat{\sigma}_{\beta_H}$	$\hat{\alpha}_E$	$\hat{\beta}_E$	$\hat{\sigma}_{\beta_E}$	$P_{\beta_H=\beta_E}$	R^2_H	R^2_E	T
AUS	0.05	1.4	0.21	0.12	0.03	0.26	0	0.63	0	109
BEL	0.11	0.14	0.08	0.09	0.35	0.18	0.16	0.09	0.16	104
DNK	0.1	0.49	0.08	0.08	0.81	0.17	0.22	0.25	0.26	134
FIN	0.14	0.35	0.34	0.18	-0.17	0.37	0.11	0.03	0	78
FRA	0.1	0.36	0.09	0.08	-0.04	0.16	0.01	0.19	0	139
DEU	0.08	0.28	0.25	0.07	0.82	0.58	0.34	0.03	0.06	97
ITA	0.04	1.36	0.15	0.11	0.15	0.46	0.01	0.74	0	70
JPN	0.06	1.11	0.25	0.06	0.71	0.36	0.05	0.36	0.09	59
NLD	0.08	0.95	0.15	0.09	0.47	0.35	0.07	0.33	0.04	110
NOR	0.1	0.42	0.1	0.08	0.33	0.21	0.23	0.22	0.04	129
PRT	0.08	0.83	0.15	0.12	0.09	0.55	0.05	0.66	0	62
ESP	0.09	0.48	0.1	0.13	-0.11	0.27	0.02	0.21	0	109
SWE	0.11	0.25	0.09	0.1	0.24	0.35	0.34	0.09	0.02	127
CHE	0.08	0.16	0.09	0.09	-0.25	0.22	0.04	0.05	0.02	108
GBR	0.07	0.66	0.16	0.1	0.42	0.33	0.15	0.29	0.07	103
USA	0.07	0.7	0.21	0.11	-0.05	0.28	0	0.35	0	119
GME	0.08	0.62	0.39	0.1	0.24	0.33	0.18	–	–	–
POLS	0.09	0.46	0.09	0.1	0.21	0.15	0.03	0.21	0.02	1657

$\hat{\alpha}_x, \hat{\beta}_x$: Parameter estimates of equation (2), $\hat{\sigma}_{\beta_x}$: standard deviation of $\hat{\beta}_x$, $P_{\beta_H=\beta_E}$: p-value of the test $H_0 : \beta_H = \beta_E$ against $\beta_H \neq \beta_E$, R^2_x: coefficients of determination, T: Number of data points. $\hat{\sigma}_{\beta_x}$ are heteroskedasticity and autocorrelation consistent by allying the Newey-West estimator (Lags $= (4T/100)^{2/9}$) for OLS and POLS and consistent for weakly cross-correlated estimators $\hat{\theta}_i$ for GME.

Table 19: Hedging within 10 years (non-housing CPI)

	$\hat{\alpha}_H$	$\hat{\beta}_H$	$\hat{\sigma}_{\beta_H}$	$\hat{\alpha}_E$	$\hat{\beta}_E$	$\hat{\sigma}_{\beta_E}$	$P_{\beta_H=\beta_E}$	R_H^2	R_E^2	T
AUS	0.06	1.35	0.11	0.11	0.29	0.21	0	0.74	0.06	104
BEL	0.11	0.23	0.08	0.1	0.22	0.14	0.32	0.2	0.08	94
DNK	0.1	0.61	0.08	0.07	0.91	0.14	0.2	0.41	0.43	129
FIN	0.12	0.73	0.33	0.18	-0.03	0.38	0.04	0.13	0	66
FRA	0.1	0.45	0.08	0.08	0.1	0.1	0.01	0.27	0.02	134
DEU	0.08	-0.18	0.19	0.08	0.5	0.38	0.26	0.02	0.05	82
ITA	0.05	1.26	0.14	0.1	0.28	0.44	0.03	0.84	0.02	60
JPN	0.04	1.62	0.23	0.05	1.3	0.3	0.02	0.59	0.36	49
NLD	0.08	0.99	0.14	0.09	0.45	0.3	0.03	0.41	0.04	105
NOR	0.1	0.51	0.12	0.08	0.35	0.21	0.14	0.28	0.05	124
PRT	0.08	0.86	0.08	0.1	0.33	0.4	0.05	0.83	0.05	57
ESP	0.09	0.48	0.11	0.13	-0.03	0.22	0.01	0.28	0	104
SWE	0.1	0.37	0.12	0.1	0.46	0.36	0.37	0.18	0.06	122
CHE	0.07	0.2	0.07	0.1	-0.34	0.22	0	0.09	0.05	103
GBR	0.07	0.86	0.17	0.09	0.71	0.31	0.19	0.47	0.18	93
USA	0.07	0.87	0.16	0.12	-0.15	0.21	0	0.55	0.01	114
GME	0.08	0.7	0.45	0.1	0.33	0.39	0.18	–	–	–
POLS	0.09	0.6	0.08	0.1	0.27	0.14	0	0.34	0.04	1540

$\hat{\alpha}_x, \hat{\beta}_x$: Parameter estimates of equation (2), $\hat{\sigma}_{\beta_x}$: standard deviation of $\hat{\beta}_x$, $P_{\beta_H=\beta_E}$: p-value of the test $H_0 : \beta_H = \beta_E$ against $\beta_H \neq \beta_E$, R_x^2: coefficients of determination, T: Number of data points. $\hat{\sigma}_{\beta_x}$ are heteroskedasticity and autocorrelation consistent by allying the Newey-West estimator (Lags $= (4T/100)^{2/9}$) for OLS and POLS and consistent for weakly cross-correlated estimators $\hat{\theta}_i$ for GME.

Table 20: Hedging within 5 years (post 1950, non-housing CPI)

	$\hat{\alpha}_H$	$\hat{\beta}_H$	$\hat{\sigma}_{\beta_H}$	$\hat{\alpha}_E$	$\hat{\beta}_E$	$\hat{\sigma}_{\beta_E}$	$P_{\beta_H=\beta_E}$	R_H^2	R_E^2	T
AUS	0.08	1.06	0.16	0.12	0.36	0.43	0.08	0.52	0.03	61
BEL	0.12	-0.65	0.27	0.09	1.53	1.1	0.18	0.15	0.08	45
DNK	0.1	0.55	0.27	0.11	0.79	0.52	0.38	0.12	0.09	61
FIN	0.15	0.42	0.28	0.2	-0.51	0.62	0.05	0.06	0.02	61
FRA	0.14	0.23	0.32	0.1	0.22	0.55	0.34	0.01	0	61
DEU	0.06	0.63	0.34	0.14	-1.2	0.71	0.02	0.08	0.06	48
ITA	0.05	1.29	0.17	0.11	0.13	0.56	0.04	0.7	0	61
JPN	0.05	1.4	0.41	0.05	1.12	0.44	0.11	0.4	0.15	50
NLD	0.09	1.07	0.52	0.17	-1.29	0.47	0	0.12	0.1	61
NOR	0.11	0.73	0.25	0.12	0.13	0.76	0.15	0.21	0	61
PRT	0.08	0.83	0.15	0.12	0.08	0.55	0.05	0.66	0	61
ESP	0.1	0.56	0.18	0.2	-0.79	0.51	0	0.19	0.09	61
SWE	0.13	0.22	0.28	0.13	0.73	0.73	0.38	0.02	0.06	61
CHE	0.07	0.48	0.23	0.13	-1.18	0.67	0.03	0.08	0.06	61
GBR	0.09	0.71	0.22	0.1	1.13	0.33	0.36	0.22	0.26	61
USA	0.06	0.97	0.17	0.15	-0.81	0.49	0	0.44	0.07	61
GME	0.09	0.66	0.47	0.13	0.03	0.88	0.22	–	–	–
POLS	0.09	0.8	0.06	0.12	0.14	0.34	0.02	0.27	0	936

$\hat{\alpha}_x, \hat{\beta}_x$: Parameter estimates of equation (2), $\hat{\sigma}_{\beta_x}$: standard deviation of $\hat{\beta}_x$, $P_{\beta_H=\beta_E}$: p-value of the test $H_0 : \beta_H = \beta_E$ against $\beta_H \neq \beta_E$, R_x^2: coefficients of determination, T: Number of data points. $\hat{\sigma}_{\beta_x}$ are heteroskedasticity and autocorrelation consistent by allying the Newey-West estimator (Lags $= (4T/100)^{2/9}$) for OLS and POLS and consistent for weakly cross-correlated estimators $\hat{\theta}_i$ for GME.

Table 21: Hedging within 10 years (post 1950, non-housing CPI)

	$\hat{\alpha}_H$	$\hat{\beta}_H$	$\hat{\sigma}_{\beta_H}$	$\hat{\alpha}_E$	$\hat{\beta}_E$	$\hat{\sigma}_{\beta_E}$	$P_{\beta_H=\beta_E}$	R_H^2	R_E^2	T
AUS	0.08	0.94	0.09	0.11	0.66	0.3	0.17	0.69	0.19	56
BEL	0.12	-0.2	0.24	0.06	3.33	0.51	0	0.02	0.55	35
DNK	0.1	0.55	0.19	0.11	0.84	0.25	0.37	0.22	0.24	56
FIN	0.14	0.63	0.2	0.19	-0.14	0.44	0.06	0.21	0	56
FRA	0.14	0.23	0.31	0.09	0.32	0.44	0.36	0.01	0.02	56
DEU	0.04	1.21	0.24	0.14	-1.2	0.61	0	0.38	0.11	43
ITA	0.06	1.23	0.14	0.1	0.31	0.45	0.05	0.85	0.02	56
JPN	0.04	1.81	0.28	0.04	1.57	0.31	0.05	0.63	0.43	45
NLD	0.09	1.15	0.46	0.17	-1.22	0.44	0	0.22	0.15	56
NOR	0.12	0.71	0.19	0.12	0.1	0.51	0.08	0.37	0	56
PRT	0.08	0.86	0.08	0.1	0.32	0.4	0.05	0.83	0.05	56
ESP	0.11	0.55	0.15	0.19	-0.5	0.38	0	0.36	0.08	56
SWE	0.13	0.24	0.13	0.12	0.88	0.48	0.31	0.13	0.15	56
CHE	0.06	0.64	0.2	0.13	-0.96	0.61	0.02	0.19	0.09	56
GBR	0.09	0.86	0.13	0.1	1.25	0.25	0.31	0.54	0.46	56
USA	0.06	1.03	0.11	0.14	-0.53	0.38	0	0.7	0.05	56
GME	0.09	0.78	0.46	0.12	0.31	1.12	0.27	–	–	–
POLS	0.09	0.87	0.05	0.12	0.34	0.26	0.02	0.41	0.03	851

$\hat{\alpha}_x, \hat{\beta}_x$: Parameter estimates of equation (2), $\hat{\sigma}_{\beta_x}$: standard deviation of $\hat{\beta}_x$, $P_{\beta_H=\beta_E}$: p-value of the test $H_0: \beta_H = \beta_E$ against $\beta_H \neq \beta_E$, R_x^2: coefficients of determination, T: Number of data points. $\hat{\sigma}_{\beta_x}$ are heteroskedasticity and autocorrelation consistent by allying the Newey-West estimator (Lags $= (4T/100)^{2/9}$) for OLS and POLS and consistent for weakly cross-correlated estimators $\hat{\theta}_i$ for GME.

A.2 Asset prices

Table 22: Hedging within one year (asset price index)

	$\hat{\alpha}_H$	$\hat{\beta}_H$	$\hat{\sigma}_{\beta_H}$	$\hat{\alpha}_E$	$\hat{\beta}_E$	$\hat{\sigma}_{\beta_E}$	$P_{\beta_H=\beta_E}$	R^2_H	R^2_E	T
AUS	0.02	0.98	0.25	0.06	0.05	0.32	0.01	0.12	0	144
BEL	0.05	0.17	0.11	0.04	0.41	0.25	0.27	0.07	0.08	136
CAN	0.02	1.35	0.26	0.05	0.26	0.73	0.08	0.42	0	86
DNK	0.02	0.59	0.12	0.04	0.58	0.28	0.34	0.21	0.04	139
FIN	0.08	0.02	0.03	0.11	0.02	0.07	0.34	0	0	100
FRA	0.05	0.34	0.09	0.05	-0.07	0.14	0	0.17	0	144
DEU	0.04	0.06	0.01	-0.02	1.96	0.04	0	0.24	0.97	118
ITA	0.03	0.94	0.08	0.07	0.37	0.07	0	0.8	0.17	87
JPN	0.1	0.04	0.01	0.09	0	0.01	0	0.03	0	99
NLD	0.04	0.45	0.37	0.09	-0.7	0.42	0.01	0.03	0.01	84
NOR	0.03	0.39	0.1	0.04	0.25	0.24	0.22	0.1	0.01	134
PRT	0.06	0.53	0.16	0.09	0.1	0.6	0.18	0.14	0	66
ESP	0.03	0.65	0.12	0.07	0	0.26	0.01	0.15	0	114
SWE	0.03	0.23	0.1	0.06	0.15	0.4	0.3	0.04	0	139
CHE	0.03	0.37	0.13	0.07	-0.53	0.25	0	0.11	0.02	79
GBR	0.03	0.64	0.18	0.04	0.51	0.56	0.3	0.14	0.02	112
USA	0.02	0.63	0.21	0.08	-0.54	0.48	0	0.12	0.02	124
GME	0.04	0.49	0.35	0.06	0.17	0.57	0.24	–	–	–
POLS	0.05	0.12	0.04	0.03	0.93	0.62	0.29	0.09	0.39	1905

$\hat{\alpha}_x, \hat{\beta}_x$: Parameter estimates of equation (1), $\hat{\sigma}_{\beta_x}$: standard deviation of $\hat{\beta}_x$, $P_{\beta_H=\beta_E}$: p-value of the test $H_0 : \beta_H = \beta_E$ against $\beta_H \neq \beta_E$, R^2_x: coefficients of determination, T: Number of data points. $\hat{\sigma}_{\beta_x}$ are heteroskedasticity and autocorrelation consistent by allying the Newey-West estimator (Lags $= (4T/100)^{2/9}$) for OLS and POLS and consistent for weakly cross-correlated estimators $\hat{\theta}_i$ for GME.

Table 23: Hedging within one year (post 1950, asset price index)

	$\hat{\alpha}_H$	$\hat{\beta}_H$	$\hat{\sigma}_{\beta_H}$	$\hat{\alpha}_E$	$\hat{\beta}_E$	$\hat{\sigma}_{\beta_E}$	$P_{\beta_H=\beta_E}$	R^2_H	R^2_E	T
AUS	0.05	0.89	0.38	0.1	-0.44	0.5	0.02	0.05	0.01	66
BEL	0.04	0.58	0.46	0.11	-1.02	0.89	0.08	0.08	0.02	66
CAN	0.01	1.53	0.48	0.07	-0.07	0.78	0.03	0.3	0	59
DNK	0.05	0.36	0.32	0.12	-0.36	0.82	0.19	0.03	0	66
FIN	0.05	0.81	0.37	0.19	-1.07	0.93	0.01	0.1	0.02	66
FRA	0.07	0.65	0.23	0.11	-0.75	0.71	0.03	0.12	0.02	66
DEU	0.01	1.03	0.3	0.12	-1.8	1.11	0.01	0.15	0.02	53
ITA	-0.01	1.57	0.41	0.09	-0.06	0.8	0.04	0.43	0	66
JPN	0.05	1.41	0.46	0.08	0.41	0.7	0.06	0.22	0.01	66
NLD	0.05	0.42	0.61	0.13	-1.48	0.65	0.01	0.02	0.04	66
NOR	0.05	0.42	0.43	0.12	-0.72	0.68	0.07	0.03	0.01	66
PRT	0.03	0.67	0.17	0.12	-0.2	0.67	0.06	0.34	0	49
ESP	0.06	0.49	0.23	0.17	-1.14	0.51	0	0.06	0.07	66
SWE	0.06	0.1	0.35	0.15	-0.46	0.8	0.23	0	0.01	66
CHE	0.02	0.42	0.33	0.12	-1.61	1.07	0.04	0.05	0.03	56
GBR	0.06	0.38	0.28	0.03	1.31	1.1	0.37	0.04	0.05	66
USA	0.02	0.74	0.2	0.14	-1.39	0.77	0	0.25	0.05	66
GME	0.04	0.73	0.42	0.12	-0.64	0.77	0.04	–	–	–
POLS	0.04	0.77	0.07	0.11	-0.32	0.32	0	0.12	0	1075

$\hat{\alpha}_x, \hat{\beta}_x$: Parameter estimates of equation (1), $\hat{\sigma}_{\beta_x}$: standard deviation of $\hat{\beta}_x$, $P_{\beta_H=\beta_E}$: p-value of the test $H_0 : \beta_H = \beta_E$ against $\beta_H \neq \beta_E$, R^2_x: coefficients of determination, T: Number of data points. $\hat{\sigma}_{\beta_x}$ are heteroskedasticity and autocorrelation consistent by allying the Newey-West estimator (Lags $= (4T/100)^{2/9}$) for OLS and POLS and consistent for weakly cross-correlated estimators $\hat{\theta}_i$ for GME.

Table 24: Hedging within 5 years (asset price index)

	$\hat{\alpha}_H$	$\hat{\beta}_H$	$\hat{\sigma}_{\beta_H}$	$\hat{\alpha}_E$	$\hat{\beta}_E$	$\hat{\sigma}_{\beta_E}$	$P_{\beta_H=\beta_E}$	R^2_H	R^2_E	T
AUS	0.01	1.38	0.22	0.05	0.32	0.25	0	0.58	0.04	139
BEL	0.04	0.24	0.11	0.03	0.47	0.2	0.15	0.13	0.2	131
CAN	0.02	1.34	0.11	0.05	0.51	0.47	0.05	0.73	0.05	77
DNK	0.02	0.8	0.09	0.03	0.85	0.22	0.37	0.43	0.19	134
FIN	0.07	0.13	0.05	0.12	0.06	0.1	0.23	0.06	0	87
FRA	0.05	0.44	0.08	0.05	-0.01	0.16	0	0.29	0	139
DEU	0.02	0.14	0.02	0	1.61	0.14	0	0.38	0.9	105
ITA	0.01	1.13	0.06	0.06	0.52	0.03	0	0.95	0.52	82
JPN	0.08	0.13	0.08	0.07	0.04	0.05	0.01	0.05	0.01	90
NLD	0.01	1.29	0.49	0.1	-0.81	0.43	0	0.19	0.04	75
NOR	0.03	0.52	0.11	0.03	0.39	0.28	0.22	0.28	0.05	129
PRT	0.06	0.55	0.18	0.05	0.24	0.5	0.18	0.33	0.02	57
ESP	0.04	0.59	0.1	0.08	-0.1	0.31	0.01	0.28	0	109
SWE	0.03	0.33	0.1	0.06	0.37	0.42	0.36	0.12	0.03	134
CHE	0.03	0.28	0.11	0.07	-0.59	0.28	0	0.1	0.07	70
GBR	0.02	0.81	0.15	0.05	0.55	0.3	0.14	0.37	0.11	103
USA	0.01	0.93	0.19	0.07	0	0.38	0	0.47	0	119
GME	0.03	0.65	0.42	0.06	0.26	0.52	0.23	–	–	–
POLS	0.04	0.45	0.13	0.04	0.66	0.28	0.38	0.32	0.27	1780

$\hat{\alpha}_x, \hat{\beta}_x$: Parameter estimates of equation (2), $\hat{\sigma}_{\beta_x}$: standard deviation of $\hat{\beta}_x$, $P_{\beta_H=\beta_E}$: p-value of the test $H_0 : \beta_H = \beta_E$ against $\beta_H \neq \beta_E$, R^2_x: coefficients of determination, T: Number of data points. $\hat{\sigma}_{\beta_x}$ are heteroskedasticity and autocorrelation consistent by allying the Newey-West estimator (Lags $= (4T/100)^{2/9}$) for OLS and POLS and consistent for weakly cross-correlated estimators $\hat{\theta}_i$ for GME.

Table 25: Hedging within 10 years (asset price index)

	$\hat{\alpha}_H$	$\hat{\beta}_H$	$\hat{\sigma}_{\beta_H}$	$\hat{\alpha}_E$	$\hat{\beta}_E$	$\hat{\sigma}_{\beta_E}$	$P_{\beta_H=\beta_E}$	R^2_H	R^2_E	T
AUS	0.01	1.32	0.12	0.05	0.53	0.18	0	0.74	0.22	134
BEL	0.04	0.37	0.11	0.04	0.37	0.15	0.34	0.26	0.15	126
CAN	0.02	1.32	0.1	0.04	0.51	0.2	0	0.84	0.2	67
DNK	0.01	0.98	0.08	0.02	0.93	0.18	0.3	0.65	0.3	129
FIN	0.05	0.41	0.12	0.14	-0.16	0.11	0	0.29	0.02	72
FRA	0.04	0.52	0.05	0.04	0.15	0.1	0	0.39	0.03	134
DEU	0.02	0.11	0.01	0.01	1.47	0.13	0	0.28	0.88	90
ITA	0.01	1.12	0.03	0.06	0.57	0.03	0	0.97	0.61	77
JPN	0.07	0.2	0.14	0.06	0.08	0.11	0	0.05	0.01	80
NLD	0.01	1.45	0.4	0.1	-0.89	0.47	0	0.32	0.08	65
NOR	0.03	0.61	0.11	0.03	0.45	0.27	0.18	0.35	0.07	124
PRT	0.05	0.59	0.1	0.06	0.12	0.31	0.04	0.65	0.01	47
ESP	0.04	0.6	0.11	0.08	-0.02	0.26	0.01	0.38	0	104
SWE	0.03	0.46	0.11	0.05	0.68	0.39	0.38	0.26	0.1	129
CHE	0.03	0.24	0.15	0.11	-1.46	0.38	0	0.06	0.3	60
GBR	0.02	1	0.14	0.04	0.85	0.23	0.19	0.57	0.29	93
USA	0.01	1.01	0.12	0.07	-0.02	0.24	0	0.67	0	114
GME	0.03	0.72	0.41	0.06	0.24	0.66	0.21	–	–	–
POLS	0.03	0.64	0.14	0.04	0.59	0.15	0.31	0.47	0.26	1645

$\hat{\alpha}_x, \hat{\beta}_x$: Parameter estimates of equation (2), $\hat{\sigma}_{\beta_x}$: standard deviation of $\hat{\beta}_x$, $P_{\beta_H=\beta_E}$: p-value of the test $H_0 : \beta_H = \beta_E$ against $\beta_H \neq \beta_E$, R^2_x: coefficients of determination, T: Number of data points. $\hat{\sigma}_{\beta_x}$ are heteroskedasticity and autocorrelation consistent by allying the Newey-West estimator (Lags $= (4T/100)^{2/9}$) for OLS and POLS and consistent for weakly cross-correlated estimators $\hat{\theta}_i$ for GME.

Table 26: Hedging within 5 years (post 1950, asset price index)

	$\hat{\alpha}_H$	$\hat{\beta}_H$	$\hat{\sigma}_{\beta_H}$	$\hat{\alpha}_E$	$\hat{\beta}_E$	$\hat{\sigma}_{\beta_E}$	$P_{\beta_H=\beta_E}$	R^2_H	R^2_E	T
AUS	0.04	0.86	0.17	0.07	0.27	0.41	0.11	0.39	0.02	61
BEL	0.04	0.67	0.51	0.09	-0.52	0.64	0.11	0.15	0.02	61
CAN	0.02	1.29	0.2	0.06	0.25	0.47	0.02	0.58	0.02	54
DNK	0.04	0.61	0.27	0.08	0.5	0.57	0.31	0.15	0.03	61
FIN	0.06	0.59	0.25	0.18	-0.92	0.82	0.02	0.12	0.04	61
FRA	0.07	0.72	0.3	0.08	-0.26	0.5	0.06	0.12	0.01	61
DEU	0	1.29	0.3	0.11	-1.32	0.84	0	0.28	0.06	48
ITA	0	1.34	0.17	0.06	0.37	0.58	0.07	0.72	0.02	61
JPN	0.03	1.78	0.62	0.05	0.96	0.48	0.03	0.29	0.09	61
NLD	0.02	1.19	0.53	0.13	-1.29	0.51	0	0.15	0.09	61
NOR	0.05	0.65	0.27	0.09	0.06	0.77	0.14	0.15	0	61
PRT	0.02	0.74	0.18	0.06	0.1	0.52	0.05	0.63	0	40
ESP	0.07	0.5	0.2	0.17	-0.97	0.52	0	0.15	0.12	61
SWE	0.06	0.17	0.28	0.1	0.54	0.74	0.38	0.01	0.03	61
CHE	0.02	0.49	0.27	0.1	-0.9	0.8	0.08	0.09	0.04	51
GBR	0.04	0.78	0.22	0.05	1.03	0.28	0.38	0.25	0.25	61
USA	0.01	1.02	0.17	0.12	-0.86	0.43	0	0.5	0.08	61
GME	0.03	0.86	0.39	0.09	-0.18	0.74	0.09	–	–	–
POLS	0.03	0.85	0.06	0.09	0.05	0.31	0	0.27	0	986

Table 27: Hedging within 10 years (post 1950, asset price index)

	$\hat{\alpha}_H$	$\hat{\beta}_H$	$\hat{\sigma}_{\beta_H}$	$\hat{\alpha}_E$	$\hat{\beta}_E$	$\hat{\sigma}_{\beta_E}$	$P_{\beta_H=\beta_E}$	R^2_H	R^2_E	T
AUS	0.05	0.72	0.1	0.06	0.5	0.29	0.21	0.54	0.14	56
BEL	0.04	0.55	0.22	0.08	-0.37	0.48	0.07	0.27	0.02	56
CAN	0.02	1.17	0.18	0.06	0.25	0.25	0.01	0.7	0.05	49
DNK	0.05	0.58	0.15	0.08	0.46	0.3	0.28	0.32	0.07	56
FIN	0.05	0.69	0.16	0.17	-0.64	0.58	0.02	0.33	0.05	56
FRA	0.07	0.72	0.24	0.08	-0.24	0.42	0.04	0.14	0.01	56
DEU	-0.02	1.82	0.26	0.12	-1.44	0.7	0	0.65	0.14	43
ITA	0.01	1.28	0.14	0.06	0.48	0.47	0.07	0.87	0.05	56
JPN	0.02	1.95	0.44	0.04	1.34	0.32	0.01	0.36	0.29	56
NLD	0.03	1.21	0.43	0.13	-1.37	0.47	0	0.26	0.19	56
NOR	0.05	0.63	0.23	0.09	0.04	0.53	0.08	0.25	0	56
PRT	0.03	0.7	0.09	0.06	0.09	0.32	0.02	0.83	0.01	30
ESP	0.07	0.45	0.14	0.16	-0.71	0.39	0	0.3	0.15	56
SWE	0.06	0.18	0.14	0.09	0.79	0.49	0.33	0.07	0.11	56
CHE	0.02	0.64	0.23	0.1	-0.76	0.64	0.04	0.19	0.06	46
GBR	0.04	0.89	0.14	0.05	1.11	0.22	0.37	0.54	0.5	56
USA	0.01	0.98	0.09	0.11	-0.69	0.35	0	0.72	0.09	56
GME	0.03	0.89	0.45	0.09	-0.07	0.78	0.13	–	–	–
POLS	0.03	0.85	0.05	0.08	0.16	0.21	0	0.39	0.01	896

$\hat{\alpha}_x, \hat{\beta}_x$: Parameter estimates of equation (2), $\hat{\sigma}_{\beta_x}$: standard deviation of $\hat{\beta}_x$, $P_{\beta_H=\beta_E}$: p-value of the test $H_0 : \beta_H = \beta_E$ against $\beta_H \neq \beta_E$, R^2_x: coefficients of determination, T: Number of data points. $\hat{\sigma}_{\beta_x}$ are heteroskedasticity and autocorrelation consistent by allying the Newey-West estimator (Lags $= (4T/100)^{2/9}$) for OLS and POLS and consistent for weakly cross-correlated estimators $\hat{\theta}_i$ for GME.

Table 28: Price Indices, perfect Hedge

	Housing					Equity				
	t_1	t_2	$\hat{\delta}$	$\hat{\phi}$	L	t_1	t_2	$\hat{\delta}$	$\hat{\phi}$	L
AUS	0.77	0.71	1.6	0.95	0	0.08	0.09	1.85	0.88	0
BEL	0.1	0.06	0.77	0.92	1	–	–	–	–	–
CAN	0.02	0.01	2.42	0.81	1	0.01	0	1.87	0.73	1
DNK	0.18	0.16	1.06	0.93	1	0.99	0.99	0.21	1	0
FIN	–	–	–	–	–	–	–	–	–	–
FRA	0.76	0.76	1.04	0.98	1	0.66	0.65	-4.63	0.96	1
DEU	–	–	–	–	–	0.55	0.51	-0.9	0.93	0
ITA	0.22	0.19	1.97	0.84	0	0.35	0.32	-1.66	0.86	0
JPN	0.83	0.81	3.69	0.95	0	0.69	0.7	-1.98	0.95	1
NLD	0.85	0.82	0.63	0.98	2	–	–	–	–	–
NOR	–	–	–	–	–	0.85	0.76	-1.1	0.96	0
PRT	0.16	0.3	2.03	0.89	1	–	–	–	–	–
ESP	0.46	0.57	0.97	0.93	0	0.11	0.05	-0.3	0.89	1
SWE	–	–	–	–	–	0.97	0.97	1.17	0.99	0
CHE	0.02	0	0.72	0.88	1	–	–	–	–	–
GBR	0.78	0.77	0.98	0.97	1	0.45	0.44	0.55	0.91	0
USA	0.07	0.05	0.44	0.83	0	0.33	0.26	2.08	0.89	0
GME	0.04	0.16	1.41	0.91		0.53	0.85	-0.24	0.91	

t_1 for ISO: Left-hand tail p-value of $(\hat{\phi}_{ix}-1)/\hat{\sigma}_{\phi_{ix}}$, for GME: p-value from the Im, Pesaran, and Shin test, t_2 for ISO: Left-hand tail p-value of $T(\hat{\phi}_{ix}-1)$, for GME: p-value from the Levin, Lin, and Chu. Variables with hats are estimates from equation (3). The lag L selection rests on Bayesian information criterion with maximal 12 lags.

Table 29: Price Indices, non-perfect Hedge without trend component

	Housing					Equity				
	t_1	t_2	$\hat{\beta}$	$\hat{\phi}$	L	t_1	t_2	$\hat{\beta}$	$\hat{\phi}$	L
AUS	0.06	0.03	1.47	0.85	0	0.21	0.43	1.44	0.93	0
BEL	0.12	0.05	1.12	0.92	1	–	–	–	–	–
CAN	0.33	0.19	1.65	0.91	1	0.02	0.01	1.48	0.8	1
DNK	0.02	0.01	1.3	0.89	1	0.96	0.95	1.1	0.99	0
FIN	–	–	–	–	–	–	–	–	–	–
FRA	0.64	0.62	1.14	0.98	1	0.51	0.45	0.33	0.94	0
DEU	–	–	–	–	–	0.11	0.06	0.95	0.87	0
ITA	0.25	0.32	1.19	0.87	0	0.21	0.17	0.81	0.84	0
JPN	0.52	0.53	1.31	0.93	1	0.66	0.65	0.7	0.95	1
NLD	0.57	0.55	1.27	0.96	2	–	–	–	–	–
NOR	–	–	–	–	–	0.78	0.71	0.73	0.96	0
PRT	0.15	0.35	1.21	0.91	1	–	–	–	–	–
ESP	0.45	0.5	1.14	0.93	0	0.09	0.04	0.94	0.89	1
SWE	–	–	–	–	–	0.74	0.66	1.4	0.97	1
CHE	0.02	0	1.26	0.89	1	–	–	–	–	–
GBR	0.52	0.47	1.25	0.95	1	0.34	0.31	1.14	0.91	0
USA	0.02	0.01	1.15	0.8	0	0.18	0.13	1.7	0.88	0
GME	0.00	0.00	1.27	0.91		0.11	0.15	1.06	0.91	

t_1 for ISO: Left-hand tail p-value of $(\hat{\phi}_{ix}-1)/\hat{\sigma}_{\phi_{ix}}$, for GME: p-value from Pedroni's (2004) Group ADF-test, t_2 for ISO: Left-hand tail p-value of $T(\hat{\phi}_{ix}-1)$, for GME: p-value from the Pedroni's (2004) Panel ADF-test. Variables with hats are estimates from equation (4) and (5). The lag L selection rests on Bayesian information criterion with maximal 12 lags.

Table 30: Price Indices, non-perfect Hedge with trend component

	Housing						Equity					
	t_1	t_2	$\hat{\delta}$	$\hat{\beta}$	$\hat{\phi}$	L	t_1	t_2	$\hat{\delta}$	$\hat{\beta}$	$\hat{\phi}$	L
AUS	0.17	0.1	0.16	1.43	0.85	0	0.01	0.01	3.46	0.52	0.75	0
BEL	0.11	0.22	3.56	0.44	0.91	1	–	–	–	–	–	–
CAN	0.04	0.01	1.66	1.21	0.78	1	0.02	0	2.68	0.77	0.73	1
DNK	0.06	0.03	-0.1	1.33	0.88	1	0.99	0.98	-1.73	1.55	0.98	0
FIN	–	–	–	–	–	–	–	–	–	–	–	–
FRA	0.89	0.89	1.11	0.99	0.98	1	0.66	0.63	1.66	0.11	0.93	0
DEU	–	–	–	–	–	–	0	0	2.04	0.9	0.72	0
ITA	0.29	0.34	1.52	1.05	0.82	0	0.43	0.44	1.36	0.68	0.84	0
JPN	0.93	0.93	3.75	0.99	0.95	0	0.86	0.92	5.19	0.26	0.95	0
NLD	0.58	0.62	-0.63	1.48	0.95	2	–	–	–	–	–	–
NOR	–	–	–	–	–	–	0.91	0.86	-1.95	1.24	0.95	0
PRT	0.42	0.43	4.69	0.66	0.87	1	–	–	–	–	–	–
ESP	0.69	0.74	0.09	1.13	0.93	0	0.14	0.09	3.28	0.48	0.87	1
SWE	–	–	–	–	–	–	0.7	0.6	-2.33	2.04	0.94	1
CHE	0.12	0.06	1.58	0.65	0.89	1	–	–	–	–	–	–
GBR	0.53	0.36	-1.8	1.65	0.93	1	0.55	0.54	-1.17	1.4	0.9	0
USA	0.06	0.06	-0.02	1.16	0.8	0	0.43	0.39	1.01	1.37	0.88	0
GME	0.01	0.08	1.20	1.09	0.89		0.09	0.34	1.13	0.94	0.87	

t_1 for ISO: Left-hand tail p-value of $(\hat{\phi}_{ix}-1)/\hat{\sigma}_{\phi_{ix}}$, for GME: p-value from Pedroni's (2004) Group ADF-test, t_2 for ISO: Left-hand tail p-value of $T(\hat{\phi}_{ix}-1)$, for GME: p-value from the Pedroni's (2004) Panel ADF-test. Variables with hats are estimates from equation (4) and (5). The lag L selection rests on Bayesian information criterion with maximal 12 lags.

Table 31: Price Indices, perfect Hedge (post 1950)

	Housing					Equity				
	t_1	t_2	$\hat{\delta}$	$\hat{\phi}$	L	t_1	t_2	$\hat{\delta}$	$\hat{\phi}$	L
AUS	0.24	0.4	2.7	0.83	0	0.08	0.07	1.39	0.72	0
BEL	0.21	0.14	2.31	0.89	1	0.72	0.71	1.4	0.9	0
CAN	0.02	0	2.62	0.74	1	0.36	0.33	1.94	0.82	0
DNK	0.25	0.15	1.72	0.88	1	0.55	0.54	3.52	0.86	0
FIN	0.01	0	2.04	0.76	3	–	–	–	–	–
FRA	0.01	0.47	3.78	0.95	1	0.87	0.88	-1.12	0.94	0
DEU	–	–	–	–	–	0.01	0.09	3.22	0.73	0
ITA	0.66	0.49	1.97	0.85	0	0.68	0.71	-1.15	0.9	0
JPN	0.05	0.86	3.48	0.96	4	0.13	0.19	3.24	0.84	1
NLD	0.02	0	2.67	0.86	1	–	–	–	–	–
NOR	–	–	–	–	–	0.61	0.66	1.02	0.89	0
PRT	0.59	0.57	1.42	0.93	1	–	–	–	–	–
ESP	0.06	0	2.36	0.8	2	0.45	0.37	0.23	0.9	1
SWE	–	–	–	–	–	0.41	0.45	5.22	0.84	0
CHE	0.27	0.07	0.52	0.88	1	–	–	–	–	–
GBR	0	0	3	0.76	1	0.19	0.15	2.42	0.77	0
USA	0.11	0.06	0.65	0.89	3	0.58	0.62	2.95	0.88	0
GME	0.00	0.00	2.23	0.86		0.15	0.02	1.87	0.85	

t_1 for ISO: Left-hand tail p-value of $(\hat{\phi}_{ix}-1)/\hat{\sigma}_{\phi_{ix}}$, for GME: p-value from the Im, Pesaran, and Shin test, t_2 for ISO: Left-hand tail p-value of $T(\hat{\phi}_{ix}-1)$, for GME: p-value from the Levin, Lin, and Chu. Variables with hats are estimates from equation (3). The lag L selection rests on Bayesian information criterion with maximal 12 lags.

Table 32: Price Indices, non-perfect Hedge without trend component (post 1950)

	Housing					Equity				
	t_1	t_2	$\hat{\beta}$	$\hat{\phi}$	L	t_1	t_2	$\hat{\beta}$	$\hat{\phi}$	L
AUS	0.93	0.91	1.47	0.97	2	0.13	0.12	1.22	0.77	0
BEL	0.44	0.46	1.56	0.94	1	0.73	0.7	1.29	0.91	0
CAN	0.29	0.18	1.59	0.87	1	0.57	0.56	1.4	0.88	0
DNK	0.31	0.22	1.31	0.9	1	0.87	0.8	1.6	0.94	0
FIN	0.56	0.38	1.35	0.9	4	–	–	–	–	–
FRA	0.01	0.14	1.73	0.94	1	0.76	0.76	0.68	0.93	0
DEU	–	–	–	–	–	0.03	0.13	2.06	0.77	0
ITA	0.24	0.15	1.29	0.79	0	0.57	0.61	0.8	0.9	0
JPN	0.44	0.3	2.1	0.96	4	0.02	0.01	1.93	0.75	1
NLD	0.07	0.04	1.68	0.89	1	–	–	–	–	–
NOR	–	–	–	–	–	0.63	0.65	1.13	0.9	0
PRT	0.58	0.56	1.12	0.94	1	–	–	–	–	–
ESP	0.12	0.03	1.28	0.86	2	0.38	0.3	0.96	0.9	1
SWE	–	–	–	–	–	0.71	0.67	1.95	0.91	0
CHE	0.31	0.08	1.15	0.9	1	–	–	–	–	–
GBR	0.53	0.38	1.51	0.92	2	0.32	0.29	1.39	0.83	0
USA	0.13	0.03	1.16	0.9	1	0.64	0.67	1.68	0.91	0
GME	0.00	0.09	1.45	0.90		0.23	0.13	1.39	0.87	

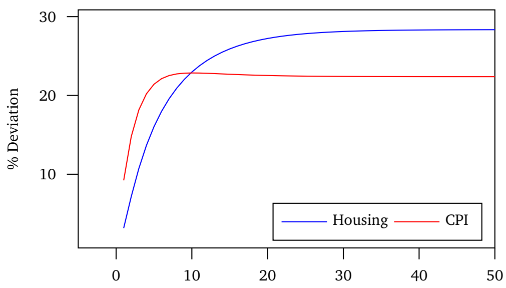
t_1 for ISO: Left-hand tail p-value of $(\hat{\phi}_{ix}-1)/\hat{\sigma}_{\phi_{ix}}$, for GME: p-value from Pedroni's (2004) Group ADF-test, t_2 for ISO: Left-hand tail p-value of $T(\hat{\phi}_{ix}-1)$, for GME: p-value from the Pedroni's (2004) Panel ADF-test. Variables with hats are estimates from equation (4) and (5). The lag L selection rests on Bayesian information criterion with maximal 12 lags.

Table 33: Price Indices, non-perfect Hedge with trend component (post 1950)

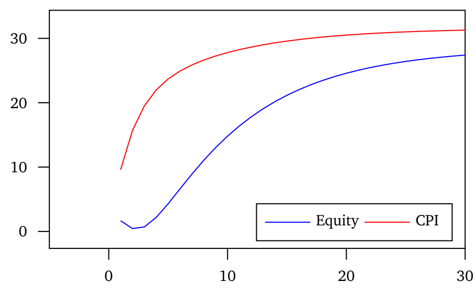
	Housing						Equity					
	t_1	t_2	$\hat{\delta}$	$\hat{\beta}$	$\hat{\phi}$	L	t_1	t_2	$\hat{\delta}$	$\hat{\beta}$	$\hat{\phi}$	L
AUS	0.1	0.26	4.57	0.65	0.75	0	0.07	0.07	5.17	0.29	0.65	0
BEL	0.01	0	4.45	0.44	0.77	2	0.71	0.74	6.84	-0.43	0.87	0
CAN	0.05	0.01	2.69	0.98	0.74	1	0.09	0.07	5.73	0.1	0.65	0
DNK	0.46	0.32	2.87	0.77	0.88	1	0.26	0.34	8.75	-0.03	0.77	0
FIN	0.65	0.43	2.68	0.88	0.86	4	–	–	–	–	–	–
FRA	0.06	0.41	2.98	1.16	0.95	1	0.78	0.81	7.72	-0.78	0.89	0
DEU	–	–	–	–	–	–	0.02	0.11	8.66	-0.92	0.68	0
ITA	0.48	0.38	0.59	1.21	0.78	0	0.82	0.83	3.53	0.3	0.89	0
JPN	0.44	0.42	-2.38	2.68	0.94	3	0.07	0.05	-0.03	1.94	0.75	1
NLD	0.05	0.01	3.3	0.83	0.86	1	–	–	–	–	–	–
NOR	–	–	–	–	–	–	0.59	0.67	8.34	-0.46	0.85	0
PRT	0.74	0.7	3.84	0.74	0.92	1	–	–	–	–	–	–
ESP	0.1	0	4.52	0.71	0.75	2	0.55	0.32	10.53	-0.36	0.85	1
SWE	–	–	–	–	–	–	0.55	0.61	7.59	0.53	0.84	0
CHE	0.29	0.14	1.54	0.64	0.87	1	–	–	–	–	–	–
GBR	0	0	3.59	0.89	0.76	1	0.3	0.26	4.91	0.55	0.74	0
USA	0.12	0.03	1.07	0.89	0.88	1	0.62	0.64	8.77	-0.48	0.84	0
GME	0.00	0.00	2.59	0.96	0.83		0.04	0.02	6.65	0.19	0.79	

t_1 for ISO: Left-hand tail p-value of $(\hat{\phi}_{ix}-1)/\hat{\sigma}_{\phi_{ix}}$, for GME: p-value from Pedroni's (2004) Group ADF-test, t_2 for ISO: Left-hand tail p-value of $T(\hat{\phi}_{ix}-1)$, for GME: p-value from the Pedroni's (2004) Panel ADF-test. Variables with hats are estimates from equation (4) and (5). The lag L selection rests on Bayesian information criterion with maximal 12 lags.

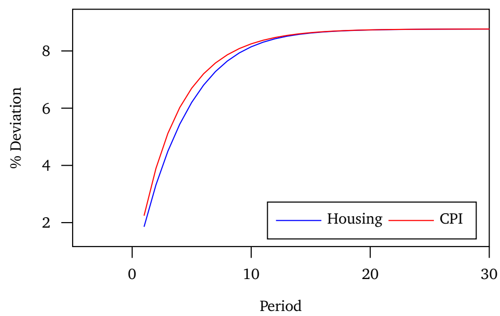
Figure 4: IRFs of VECMs (Price Indices)



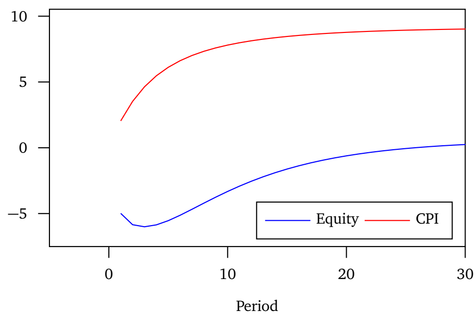
(a) IRF CPI → Housing



(b) IRF CPI → Equity



(c) IRF CPI → Housing (post 1950)



(d) IRF CPI → Equity (post 1950)

B Unit-root tests

Table 34: Unit-root tests (post 1950)

	H_0: Unit-root			H_0: Stationarity			
	P_H	P_E	P_C	P_H	P_E	P_C	T
AUS	0.95	0.11	0.82	0.09	0.1	0.1	66
BEL	0.38	0.67	0.93	0.1	0.09	0.08	66
DNK	0.61	0.15	1	0.02	0.1	0.04	66
FIN	0.26	0.11	0.75	0.02	0.1	0.03	66
FRA	0.08	0.84	0.59	0.01	0.07	0.04	66
DEU	0.73	0	0.93	0.02	0.1	0.05	66
ITA	0.88	0.76	0.7	0.07	0.1	0.1	66
JPN	0.49	0.01	0.9	0.02	0.02	0.02	66
NLD	0.3	0.7	0.76	0.05	0.1	0.03	66
NOR	0.97	0.45	1	0.1	0.03	0.05	66
PRT	0.99	0.15	0.89	0.1	0.1	0.1	66
ESP	0.01	0.38	0.56	0.02	0.1	0.05	66
SWE	0.83	0.59	1	0.02	0.1	0.05	66
CHE	0.54	0.18	0.99	0.1	0.1	0.03	66
GBR	0.83	0.69	0.93	0.05	0.1	0.06	66
USA	0.25	0.55	0.97	0.1	0.1	0.1	66
GME	1.00	0.03	1.00	0.00	0.00	0.00	1056

P_x : for ISO: p-values of the ADF-test for the unit-root test and KPSS-test for stationarity and for GME: p-values of the ADF-Chi-Fisher and Hadri-test, respectively. Lag length selection rests on Bayesian information criterion. H: HPI, E: EPI, C: CPI.

Table 35: Unit-root tests (first-differences, post 1950)

	H_0: Unit-root			H_0: Stationarity			
	P_H	P_E	P_C	P_H	P_E	P_C	T
AUS	0	0	0.48	0.05	0.1	0.1	65
BEL	0.01	0	0.13	0.06	0.1	0.06	65
DNK	0	0	0.1	0.1	0.1	0.06	65
FIN	0	0	0.84	0.1	0.1	0.07	65
FRA	0.56	0	0.43	0.1	0.1	0.1	65
DEU	0.01	0	0.01	0.1	0.1	0.06	65
ITA	0	0	0.62	0.03	0.1	0.05	65
JPN	0.16	0	0	0.1	0.1	0.1	65
NLD	0.04	0	0.15	0.1	0.1	0.1	65
NOR	0	0	0	0.1	0.1	0.08	65
PRT	0	0	0.3	0.03	0.1	0.03	65
ESP	0.78	0	0.44	0.05	0.1	0.04	65
SWE	0	0	0.01	0.1	0.1	0.05	65
CHE	0	0	0.11	0.1	0.1	0.03	65
GBR	0	0	0.3	0.07	0.1	0.1	65
USA	0.06	0	0.11	0.09	0.1	0.05	65
GME	0.00	0.00	0.00	0.00	0.66	0.00	1040

P_x : for ISO: p-values of the ADF-test for the unit-root test and KPSS-test for stationarity and for GME: p-values of the ADF-Chi-Fisher and Hadri-test, respectively. Lag length selection rests on Bayesian information criterion. H: HPI, E: EPI, C: CPI.

Table 36: Unit-root tests (price indices)

	ADF			KPSS			
	P_H	P_E	P_C	P_H	P_E	P_C	T
AUS	0.34	0.28	0.4	0.01	0.01	0.01	146
BEL	0.16	0.05	0.19	0.06	0.03	0.08	138
CAN	0.23	0.08	0.75	0.04	0.03	0.04	95
DNK	0.22	0.35	0.34	0.01	0.01	0.01	141
FIN	0.5	0.03	0.81	0.1	0.06	0.04	104
FRA	0.74	0.59	0.64	0.01	0.04	0.04	146
DEU	0.04	0.82	0.9	0.1	0.03	0.02	146
ITA	0.48	0.86	0.66	0.05	0.09	0.04	89
JPN	0.77	0.59	0.93	0.03	0.1	0.02	103
NLD	0.57	0.36	0.12	0.01	0.08	0.01	146
NOR	0.04	0.73	0.33	0.01	0.01	0.01	136
PRT	0.98	0.32	0.95	0.08	0.07	0.07	85
ESP	0.18	0.09	0.61	0.01	0.02	0.03	116
SWE	0.02	0.53	0.27	0.01	0.01	0.01	141
CHE	0.44	0.26	0.09	0.07	0.03	0.09	115
GBR	0.49	0.66	0.53	0.01	0.01	0.01	121
USA	0.7	0.59	0.43	0.01	0.01	0.01	126

P_x : for ISO: p-values of the ADF-test for the unit-root test and KPSS-test for stationarity and for GME: p-values of the ADF-Chi-Fisher and Hadri-test, respectively. Lag length selection rests on Bayesian information criterion. H: House price index, E: Equity price index, C: CPI.

Table 37: Unit-root tests (price indices, first differences)

	ADF			KPSS			
	P_H	P_E	P_C	P_H	P_E	P_C	T
AUS	0	0	0	0.1	0.1	0.1	145
BEL	0	0	0	0.09	0.1	0.1	137
CAN	0	0	0	0.05	0.1	0.03	94
DNK	0	0	0	0.1	0.1	0.1	140
FIN	0	0	0.04	0.1	0.1	0.1	103
FRA	0	0	0	0.01	0.1	0.04	145
DEU	0	0	0	0.1	0.1	0.1	145
ITA	0.01	0	0	0.1	0.1	0.1	88
JPN	0.56	0	0	0.07	0.06	0.1	102
NLD	0	0	0	0.1	0.1	0.1	145
NOR	0	0	0	0.1	0.1	0.1	135
PRT	0	0	0	0.1	0.1	0.05	84
ESP	0	0	0	0.02	0.1	0.05	115
SWE	0	0	0	0.1	0.1	0.1	140
CHE	0	0	0	0.1	0.1	0.1	114
GBR	0	0	0	0.1	0.1	0.1	120
USA	0	0	0	0.1	0.1	0.1	125

P_x : for ISO: p-values of the ADF-test for the unit-root test and KPSS-test for stationarity and for GME: p-values of the ADF-Chi-Fisher and Hadri-test, respectively. Lag length selection rests on Bayesian information criterion. H: House price index, E: Equity price index, C: CPI.

Table 38: Unit-root tests (price indices, post 1950)

	ADF			KPSS			
	P_H	P_E	P_C	P_H	P_E	P_C	T
AUS	0.53	0.08	0.82	0.1	0.1	0.1	66
BEL	0.22	0.7	0.93	0.1	0.05	0.08	66
CAN	0.69	0.06	0.92	0.1	0.1	0.1	66
DNK	0.88	0.12	1	0.02	0.07	0.04	66
FIN	0.59	0.14	0.75	0.02	0.1	0.03	66
FRA	0.09	0.83	0.59	0.02	0.07	0.04	66
DEU	0.72	0	0.93	0.02	0.1	0.05	66
ITA	0.97	0.82	0.7	0.09	0.1	0.1	66
JPN	0.03	0.14	0.9	0.01	0.02	0.02	66
NLD	0.1	0.65	0.76	0.1	0.1	0.03	66
NOR	0.53	0.52	1	0.1	0.03	0.05	66
PRT	0.99	0.46	0.89	0.1	0.1	0.1	66
ESP	0.03	0.4	0.56	0.02	0.1	0.05	66
SWE	0.51	0.62	1	0.1	0.1	0.05	66
CHE	0.56	0.27	0.99	0.1	0.1	0.03	66
GBR	0.62	0.46	0.93	0.09	0.1	0.06	66
USA	0.17	0.59	0.97	0.1	0.1	0.1	66

P_x : for ISO: p-values of the ADF-test for the unit-root test and KPSS-test for stationarity and for GME: p-values of the ADF-Chi-Fisher and Hadri-test, respectively. Lag length selection rests on Bayesian information criterion. H: House price index, E: Equity price index, C: CPI.

Table 39: Unit-root tests (price indices, first-differences, post 1950)

	ADF			KPSS			
	P_H	P_E	P_C	P_H	P_E	P_C	T
AUS	0	0	0.48	0.1	0.1	0.1	65
BEL	0	0	0.13	0.1	0.1	0.06	65
CAN	0	0	0.26	0.1	0.1	0.05	65
DNK	0	0	0.1	0.1	0.1	0.06	65
FIN	0	0	0.84	0.1	0.1	0.07	65
FRA	0.45	0	0.43	0.1	0.1	0.1	65
DEU	0.02	0	0.01	0.1	0.1	0.06	65
ITA	0	0	0.62	0.04	0.1	0.05	65
JPN	0.27	0	0	0.03	0.1	0.1	65
NLD	0.03	0	0.15	0.1	0.1	0.1	65
NOR	0	0	0	0.1	0.1	0.08	65
PRT	0	0	0.3	0.04	0.1	0.03	65
ESP	0.57	0	0.44	0.07	0.1	0.04	65
SWE	0	0	0.01	0.1	0.1	0.05	65
CHE	0	0	0.11	0.1	0.1	0.03	65
GBR	0	0	0.3	0.07	0.1	0.1	65
USA	0.05	0	0.11	0.1	0.1	0.05	65

P_x : for ISO: p-values of the ADF-test for the unit-root test and KPSS-test for stationarity and for GME: p-values of the ADF-Chi-Fisher and Hadri-test, respectively. Lag length selection rests on Bayesian information criterion. H: House price index, E: Equity price index, C: CPI.

C Decomposition of expected and unexpected inflation

C.1 Design

A differentiation of hedging against expected and unexpected inflation within one year follows the Fama and Schwert (1977) model

$$r_{ixt+1} = \alpha_{ix} + \beta_{ix}^{E}\mathbb{E}_t(\pi_{it+1}) + \beta_{ix}^{U}(\pi_{it+1} - \mathbb{E}_t(\pi_{it+1})) + e_{ixt},\ x \in \{H, E\},$$
$$i = \{\text{ISO}\},\ t = 1, ..., T_i, \quad \text{(C.1)}$$

where $\mathbb{E}_t x_{t+1}$ denotes today's expectations on x at time $t+1$. I choose two approaches to determine expectations differently. The first one uses an estimated ARMAX(p,q) model (equation (C.2)). The exogenous variable is the return on treasury bill forward contracts r_{it}^{b}. This approach refers to rational expectations (see Madadpour and Asgari (2019)). The second approach is to assume simplest adaptive belief formations (equation (C.3)).

$$\mathbb{E}_t \pi_{it+1} = \pi^* + \sum_{l=0}^{p} \phi_{il} \pi_{it-l} + \beta_i^b r_{it}^b + \sum_{l=0}^{q} \psi_l \epsilon_{it-l} \tag{C.2}$$

$$\mathbb{E}_t \pi_{it+1} = \pi_{it} \tag{C.3}$$

The remaining estimation procedure follows section 3.

C.2 Results

The specifications of Tables 40-47 differ in three dimensions: First, the mentioned different expectations formations, second the different time periods (full sample and *post-war* period), third, the CPI and the non-housing CPI are considered. On average the point estimates of the relationships of expected and unexpected inflation with the return on housing is higher than the return on equity. Second, the expected inflation relation of housing and equity differ, as the hypothesis of an equal relationship can be rejected at the 5% level in all specifications. This holds for the unexpected inflation at the 10% level, except for rational expectations in the *full* sample for both, the *full* and the non-housing CPI. Albeit, the relation of expected and unexpected inflation within the return rates differ non-systematically. Further, the standard errors of the estimators are very large.

Table 40: Rational Expectations

	$\hat{\beta}_H^E$	$\hat{\sigma}_{\beta_H^E}$	$\hat{\beta}_H^U$	$\hat{\sigma}_{\beta_H^U}$	$\hat{\beta}_E^E$	$\hat{\sigma}_{\beta_E^E}$	$\hat{\beta}_E^U$	$\hat{\sigma}_{\beta_E^U}$	$P_{\beta_H^E=\beta_E^E}$	$P_{\beta_H^U=\beta_E^U}$	T
AUS	1.1	0.37	0.87	0.28	-0.2	0.52	-0.09	0.59	0.01	0.03	105
BEL	0.16	0.12	0.13	0.1	0.19	0.34	0.46	0.34	0.35	0.29	105
DNK	0.59	0.14	0.39	0.12	0.59	0.49	0.7	0.34	0.34	0.36	130
FIN	0.29	0.23	-0.03	0.26	-0.58	0.33	-0.71	0.51	0	0.03	85
FRA	0.4	0.1	0.2	0.1	-0.16	0.22	-0.04	0.19	0.01	0.13	135
DEU	0.66	0.27	0.65	0.27	-0.18	0.82	0.25	1.15	0.13	0.24	101
ITA	1.26	0.21	0.94	0.27	0.8	0.78	-1.92	0.9	0.18	0	71
JPN	0.87	0.41	0.63	0.37	-0.17	0.61	0.21	0.35	0.01	0.23	60
NLD	1.01	0.26	0.71	0.23	-0.45	0.91	1.11	0.92	0.04	0.38	106
NOR	0.38	0.11	0.38	0.14	-0.14	0.42	0.47	0.25	0.09	0.38	125
PRT	0.75	0.21	0.9	0.26	-0.02	0.85	-1.85	1.06	0.12	0.03	58
ESP	0.65	0.13	0.62	0.17	-0.44	0.39	0.19	0.25	0	0.16	105
SWE	0.31	0.11	0.03	0.12	-0.03	0.52	0.15	0.46	0.17	0.38	123
CHE	0.34	0.14	0.05	0.14	-0.28	0.28	-0.05	0.42	0.03	0.32	104
GBR	0.58	0.19	0.79	0.24	0.48	0.49	0.73	0.99	0.27	0.37	103
USA	0.73	0.19	0.4	0.32	-0.08	0.63	-1.03	0.7	0.05	0.01	115
GME	0.63	0.31	0.48	0.33	-0.04	0.38	-0.09	0.87	0.34	0.16	115
POLS	0.44	0.08	0.41	0.08	0.05	0.19	0.16	0.25	0	0.26	1631

$\hat{\beta}_x^y, y \in \{E, U\}$: Parameter estimates of equation (C.1), $\hat{\sigma}_{\beta_x^y}$: standard deviation of $\hat{\beta}_x^y$, $P_{\beta_H^y=\beta_E^y}$: p-value of the test $H_0 : \beta_H^y = \beta_E^y$ against $\beta_H^y \neq \beta_E^y$, R_x^2: coefficients of determination, T: Number of data points. $\hat{\sigma}_{\beta_x^y}$ are heteroskedasticity and autocorrelation consistent by allying the Newey-West estimator (Lags $= (4T/100)^{2/9}$) for OLS and POLS and consistent for weakly cross-correlated estimators for GME.

Table 41: Rational Expectations (post 1950)

	$\hat{\beta}_H^E$	$\hat{\sigma}_{\beta_H^E}$	$\hat{\beta}_H^U$	$\hat{\sigma}_{\beta_H^U}$	$\hat{\beta}_E^E$	$\hat{\sigma}_{\beta_E^E}$	$\hat{\beta}_E^U$	$\hat{\sigma}_{\beta_E^U}$	$P_{\beta_H^E=\beta_E^E}$	$P_{\beta_H^U=\beta_E^U}$	T
AUS	0.48	0.23	0.98	0.22	0.71	0.66	-0.57	0.85	0.28	0.1	57
BEL	0.5	0.8	-0.11	0.54	-0.37	1.77	-6.37	4	0.26	0.1	46
DNK	0.33	0.4	0.35	0.42	0.14	1.11	-0.82	1.71	0.33	0.12	57
FIN	1.13	0.55	0.67	0.46	-0.81	1.1	-2.18	1.29	0.06	0.01	57
FRA	0.79	0.32	0.73	0.38	-0.38	0.88	-0.4	0.94	0.1	0.1	57
DEU	0.64	0.33	1.6	0.43	-0.89	1.5	-3.62	2.51	0.17	0.03	53
ITA	1.34	0.31	2.49	0.99	0.6	0.79	-3.68	2.41	0.16	0.01	57
JPN	1.35	0.57	2.15	0.54	0.33	0.73	-0.36	0.8	0.04	0.02	56
NLD	0.7	0.76	0.31	0.47	-0.84	0.99	-2	1.63	0.09	0.05	57
NOR	0.62	0.41	0.32	0.55	1.19	1.53	-3.07	1.46	0.38	0	57
PRT	0.75	0.22	0.84	0.22	0.12	0.92	-1.61	0.96	0.16	0.01	57
ESP	0.66	0.26	0.62	0.45	-0.66	0.76	-2.48	1.16	0.03	0.01	57
SWE	0.25	0.35	-0.12	0.5	0.59	1.02	-2.67	1.4	0.38	0.02	57
CHE	0.18	0.33	0.76	0.32	-0.73	1.3	-2.46	1.2	0.25	0.01	57
GBR	0.28	0.27	0.63	0.39	1.85	0.72	1.93	1.82	0.29	0.35	57
USA	0.9	0.24	0.66	0.21	0.46	0.92	-5.35	1.81	0.23	0	57
GME	0.68	0.36	0.8	0.72	0.08	0.81	-2.23	2.02	0.34	0.28	57
POLS	0.79	0.08	0.85	0.19	0.19	0.43	-1.44	0.62	0.05	0	896

$\hat{\beta}_x^y, y \in \{E,U\}$: Parameter estimates of equation (C.1), $\hat{\sigma}_{\beta_x^y}$: standard deviation of $\hat{\beta}_x^y$, $P_{\beta_H^y=\beta_E^y}$: p-value of the test $H_0 : \beta_H^y = \beta_E^y$ against $\beta_H^y \neq \beta_E^y$, R_x^2: coefficients of determination, T: Number of data points. $\hat{\sigma}_{\beta_x^y}$ are heteroskedasticity and autocorrelation consistent by allying the Newey-West estimator (Lags $= (4T/100)^{2/9}$) for OLS and POLS and consistent for weakly cross-correlated estimators for GME.

Table 42: Adaptive Beliefs

	$\hat{\beta}_H^E$	$\hat{\sigma}_{\beta_H^E}$	$\hat{\beta}_H^U$	$\hat{\sigma}_{\beta_H^U}$	$\hat{\beta}_E^E$	$\hat{\sigma}_{\beta_E^E}$	$\hat{\beta}_E^U$	$\hat{\sigma}_{\beta_E^U}$	$P_{\beta_H^E=\beta_E^E}$	$P_{\beta_H^U=\beta_E^U}$	T
AUS	1.1	0.37	0.87	0.28	-0.15	0.46	-0.07	0.55	0.01	0.02	113
BEL	0.16	0.12	0.13	0.1	0.34	0.2	0.45	0.34	0.32	0.27	113
DNK	0.59	0.14	0.39	0.12	0.68	0.36	0.62	0.33	0.37	0.36	138
FIN	0.29	0.23	-0.03	0.26	-0.61	0.26	-0.48	0.37	0	0.02	92
FRA	0.4	0.1	0.2	0.1	-0.14	0.16	-0.02	0.18	0	0.13	143
DEU	0.66	0.27	0.65	0.27	0.21	0.69	0.28	0.7	0.2	0.22	109
ITA	1.26	0.21	0.94	0.27	0.45	0.37	-0.85	0.38	0.02	0	79
JPN	0.87	0.41	0.63	0.37	-0.23	0.48	0.21	0.34	0.03	0.18	68
NLD	1.01	0.26	0.71	0.23	0.28	0.54	1.01	0.86	0.09	0.38	114
NOR	0.38	0.11	0.38	0.14	0.12	0.28	0.43	0.23	0.14	0.37	133
PRT	0.75	0.21	0.9	0.26	-0.02	0.81	-1.54	0.91	0.11	0.01	66
ESP	0.65	0.13	0.62	0.17	-0.14	0.28	0.18	0.23	0.01	0.06	113
SWE	0.31	0.11	0.03	0.12	0.06	0.45	0.15	0.44	0.22	0.38	131
CHE	0.34	0.14	0.05	0.14	-0.29	0.27	0.01	0.4	0.03	0.32	112
GBR	0.58	0.19	0.79	0.24	0.67	0.58	0.36	0.85	0.36	0.25	111
USA	0.73	0.19	0.4	0.32	-0.2	0.51	-1.03	0.62	0.02	0.01	123
GME	0.63	0.31	0.48	0.33	0.06	0.66	-0.02	0.38	0.19	0.11	123
POLS	0.44	0.08	0.41	0.08	0.11	0.16	0.15	0.18	0.02	0.06	1631

$\hat{\beta}_x^y$, $y \in \{E, U\}$: Parameter estimates of equation (C.1), $\hat{\sigma}_{\beta_x^y}$: standard deviation of $\hat{\beta}_x^y$, $P_{\beta_H^y=\beta_E^y}$: p-value of the test $H_0 : \beta_H^y = \beta_E^y$ against $\beta_H^y \neq \beta_E^y$, R_x^2: coefficients of determination, T: Number of data points. $\hat{\sigma}_{\beta_x^y}$ are heteroskedasticity and autocorrelation consistent by allying the Newey-West estimator (Lags $= (4T/100)^{2/9}$) for OLS and POLS and consistent for weakly cross-correlated estimators for GME.

Table 43: Adaptive Beliefs (post 1950)

	$\hat{\beta}_H^E$	$\hat{\sigma}_{\beta_H^E}$	$\hat{\beta}_H^U$	$\hat{\sigma}_{\beta_H^U}$	$\hat{\beta}_E^E$	$\hat{\sigma}_{\beta_E^E}$	$\hat{\beta}_E^U$	$\hat{\sigma}_{\beta_E^U}$	$P_{\beta_H^E=\beta_E^E}$	$P_{\beta_H^U=\beta_E^U}$	T
AUS	0.48	0.23	0.98	0.22	-0.22	0.57	-1.2	0.85	0.06	0.01	65
BEL	0.5	0.8	-0.11	0.54	-0.08	1.42	-0.69	2.46	0.29	0.3	54
DNK	0.33	0.4	0.35	0.42	0.37	1.02	-1.74	1.01	0.34	0.02	65
FIN	1.13	0.55	0.67	0.46	-1.68	0.84	-1.14	0.9	0	0.06	65
FRA	0.79	0.32	0.73	0.38	-0.17	0.85	-1.43	1	0.12	0.04	65
DEU	0.64	0.33	1.6	0.43	-0.41	1.1	-6.76	1.95	0.15	0	53
ITA	1.34	0.31	2.49	0.99	0.21	0.81	-1.51	1.3	0.08	0.02	65
JPN	1.35	0.57	2.15	0.54	0.14	0.61	0	0.66	0.01	0	56
NLD	0.7	0.76	0.31	0.47	-1.27	0.79	-1.28	1.43	0.01	0.12	65
NOR	0.62	0.41	0.32	0.55	-0.49	0.92	-1.13	1.24	0.09	0.14	65
PRT	0.75	0.22	0.84	0.22	-0.03	0.8	-1.92	1.14	0.11	0.01	65
ESP	0.66	0.26	0.62	0.45	-0.99	0.61	-1.6	0.83	0.01	0	65
SWE	0.25	0.35	-0.12	0.5	-0.1	1.02	-0.91	1.12	0.29	0.23	65
CHE	0.18	0.33	0.76	0.32	-1.02	1.09	-2.98	1.54	0.14	0.01	65
GBR	0.28	0.27	0.63	0.39	1.7	0.94	0.99	2.22	0.29	0.36	65
USA	0.9	0.24	0.66	0.21	-0.56	0.71	-2.48	1.76	0.02	0.04	65
GME	0.68	0.36	0.8	0.72	-0.29	1.65	-1.61	0.81	0.22	0.02	65
POLS	0.79	0.08	0.85	0.19	-0.11	0.37	-1.26	0.6	0.01	0	896

$\hat{\beta}_x^y, y \in \{E, U\}$: Parameter estimates of equation (C.1), $\hat{\sigma}_{\beta_x^y}$: standard deviation of $\hat{\beta}_x^y$, $P_{\beta_H^y=\beta_E^y}$: p-value of the test $H_0 : \beta_H^y = \beta_E^y$ against $\beta_H^y \neq \beta_E^y$, R_x^2: coefficients of determination, T: Number of data points. $\hat{\sigma}_{\beta_x^y}$ are heteroskedasticity and autocorrelation consistent by allying the Newey-West estimator (Lags $= (4T/100)^{2/9}$) for OLS and POLS and consistent for weakly cross-correlated estimators for GME.

Table 44: Rationale Expectations (non-housing CPI)

	$\hat{\beta}_H^E$	$\hat{\sigma}_{\beta_H^E}$	$\hat{\beta}_H^U$	$\hat{\sigma}_{\beta_H^U}$	$\hat{\beta}_E^E$	$\hat{\sigma}_{\beta_E^E}$	$\hat{\beta}_E^U$	$\hat{\sigma}_{\beta_E^U}$	$P_{\beta_H^E=\beta_E^E}$	$P_{\beta_H^U=\beta_E^U}$	T
AUS	1.13	0.43	0.98	0.39	-0.25	0.53	-0.03	0.51	0.01	0.05	105
BEL	0.12	0.1	0.11	0.08	0.07	0.28	0.43	0.28	0.37	0.31	105
DNK	0.43	0.11	0.29	0.09	0.51	0.41	0.49	0.25	0.36	0.37	130
FIN	0.15	0.16	-0.1	0.19	-0.45	0.32	-0.68	0.39	0	0.02	85
FRA	0.31	0.1	0.14	0.09	-0.15	0.22	-0.03	0.16	0.02	0.17	135
DEU	0.42	0.27	0.41	0.27	-0.97	0.99	0.14	1.29	0.04	0.29	101
ITA	1.16	0.19	0.85	0.24	0.76	0.83	-1.6	0.71	0.2	0	71
JPN	0.35	0.32	0.5	0.3	-0.32	0.49	0.06	0.24	0.02	0.17	60
NLD	0.78	0.2	0.59	0.19	-0.49	0.73	0.93	0.77	0.03	0.38	106
NOR	0.31	0.09	0.29	0.13	-0.11	0.34	0.43	0.21	0.1	0.38	125
PRT	0.7	0.2	0.8	0.23	-0.07	0.84	-1.65	1.08	0.11	0.04	58
ESP	0.56	0.12	0.53	0.15	-0.41	0.36	0.2	0.22	0	0.21	105
SWE	0.23	0.09	0	0.09	0.05	0.45	0.16	0.38	0.2	0.37	123
CHE	0.27	0.12	-0.01	0.11	-0.25	0.22	-0.06	0.33	0.02	0.32	104
GBR	0.42	0.16	0.49	0.17	0.33	0.5	0.31	0.57	0.26	0.35	103
USA	0.56	0.17	0.28	0.2	-0.13	0.47	-0.62	0.46	0.04	0.01	115
GME	0.49	0.31	0.38	0.32	-0.12	0.41	-0.1	0.71	0.34	0.15	115
POLS	0.34	0.07	0.32	0.07	0	0.17	0.16	0.21	0	0.29	1631

$\hat{\beta}_x^y$, $y \in \{E, U\}$: Parameter estimates of equation (C.1), $\hat{\sigma}_{\beta_x^y}$: standard deviation of $\hat{\beta}_x^y$, $P_{\beta_H^y=\beta_E^y}$: p-value of the test $H_0 : \beta_H^y = \beta_E^y$ against $\beta_H^y \neq \beta_E^y$, R_x^2: coefficients of determination, T: Number of data points. $\hat{\sigma}_{\beta_x^y}$ are heteroskedasticity and autocorrelation consistent by allying the Newey-West estimator (Lags $= (4T/100)^{2/9}$) for OLS and POLS and consistent for weakly cross-correlated estimators for GME.

Table 45: Rationale Expectations (post 1950, non-housing CPI)

	$\hat{\beta}_H^E$	$\hat{\sigma}_{\beta_H^E}$	$\hat{\beta}_H^U$	$\hat{\sigma}_{\beta_H^U}$	$\hat{\beta}_E^E$	$\hat{\sigma}_{\beta_E^E}$	$\hat{\beta}_E^U$	$\hat{\sigma}_{\beta_E^U}$	$P_{\beta_H^E=\beta_E^E}$	$P_{\beta_H^U=\beta_E^U}$	T
AUS	0.53	0.26	0.86	0.28	0.74	0.81	-0.28	0.83	0.31	0.09	57
BEL	0.57	0.62	-0.06	0.56	-1.23	1.59	-5.35	3.38	0.17	0.1	46
DNK	0.26	0.34	0.31	0.36	-0.11	1.04	-0.2	1.17	0.31	0.18	57
FIN	0.61	0.34	0.19	0.62	-0.89	1.15	-2.08	1.1	0.07	0	57
FRA	0.3	0.32	0.26	0.32	0.48	0.68	-2.13	1.52	0.34	0.1	57
DEU	0.44	0.31	0.93	0.41	-11.02	3.08	-6.03	1.45	0	0	53
ITA	1.31	0.31	2.56	0.89	0.4	0.74	-3.32	2.39	0.1	0.02	57
JPN	0.74	0.32	1.83	0.48	0.5	0.73	0.16	0.57	0	0	56
NLD	0.51	0.68	0.36	0.4	-1.29	1.11	-1.37	1.57	0.08	0.1	57
NOR	0.56	0.4	0.27	0.53	0.89	1.36	-2.93	1.31	0.37	0	57
PRT	0.7	0.21	0.73	0.19	0.06	0.87	-1.49	0.86	0.15	0.01	57
ESP	0.57	0.24	0.42	0.45	-0.7	0.7	-2.32	1.18	0.02	0.04	57
SWE	0.3	0.32	-0.19	0.37	0.62	1.08	-1.18	1.11	0.38	0.06	57
CHE	0.26	0.31	0.72	0.29	-1.01	1.29	-2.61	1.16	0.2	0	57
GBR	0.22	0.25	0.3	0.22	1.73	0.7	1.69	1.71	0.32	0.34	57
USA	0.7	0.2	0.44	0.19	0.34	0.87	-3.55	1.29	0.21	0	57
GME	0.54	0.27	0.62	0.7	-0.66	2.89	-2.06	1.98	0.31	0.19	57
POLS	0.62	0.07	0.7	0.18	-0.33	0.36	-0.33	0.36	0	0	896

$\hat{\beta}_x^y$, $y \in \{E, U\}$: Parameter estimates of equation (C.1), $\hat{\sigma}_{\beta_x^y}$: standard deviation of $\hat{\beta}_x^y$, $P_{\beta_H^y=\beta_E^y}$: p-value of the test $H_0 : \beta_H^y = \beta_E^y$ against $\beta_H^y \neq \beta_E^y$, R_x^2: coefficients of determination, T: Number of data points. $\hat{\sigma}_{\beta_x^y}$ are heteroskedasticity and autocorrelation consistent by allying the Newey-West estimator (Lags $= (4T/100)^{2/9}$) for OLS and POLS and consistent for weakly cross-correlated estimators for GME.

Table 46: Adaptive Beliefs (non-housing CPI)

	$\hat{\beta}_H^E$	$\hat{\sigma}_{\beta_H^E}$	$\hat{\beta}_H^U$	$\hat{\sigma}_{\beta_H^U}$	$\hat{\beta}_E^E$	$\hat{\sigma}_{\beta_E^E}$	$\hat{\beta}_E^U$	$\hat{\sigma}_{\beta_E^U}$	$P_{\beta_H^E=\beta_E^E}$	$P_{\beta_H^U=\beta_E^U}$	T
AUS	1.13	0.43	0.98	0.39	-0.2	0.41	0.06	0.5	0.01	0.04	113
BEL	0.12	0.1	0.11	0.08	0.29	0.17	0.38	0.28	0.3	0.26	113
DNK	0.43	0.11	0.29	0.09	0.53	0.28	0.47	0.24	0.38	0.36	138
FIN	0.15	0.16	-0.1	0.19	-0.52	0.22	-0.42	0.31	0	0.04	92
FRA	0.31	0.1	0.14	0.09	-0.12	0.15	-0.01	0.15	0.01	0.18	143
DEU	0.42	0.27	0.41	0.27	-0.42	1.03	-0.37	1.02	0.12	0.13	109
ITA	1.16	0.19	0.85	0.24	0.36	0.33	-0.79	0.37	0.02	0	79
JPN	0.35	0.32	0.5	0.3	-0.38	0.38	0.14	0.26	0.04	0.18	68
NLD	0.78	0.2	0.59	0.19	0.16	0.46	0.86	0.72	0.08	0.38	114
NOR	0.31	0.09	0.29	0.13	0.12	0.24	0.4	0.2	0.17	0.38	133
PRT	0.7	0.2	0.8	0.23	-0.1	0.75	-1.4	0.77	0.09	0.01	66
ESP	0.56	0.12	0.53	0.15	-0.13	0.25	0.18	0.2	0.01	0.08	113
SWE	0.23	0.09	0	0.09	0.08	0.37	0.22	0.36	0.26	0.38	131
CHE	0.27	0.12	-0.01	0.11	-0.25	0.21	-0.01	0.32	0.03	0.34	112
GBR	0.42	0.16	0.49	0.17	0.41	0.5	0.17	0.53	0.34	0.24	111
USA	0.56	0.17	0.28	0.2	-0.18	0.37	-0.61	0.42	0.02	0.01	123
GME	0.49	0.31	0.38	0.32	-0.02	0.56	-0.05	0.41	0.19	0.16	123
POLS	0.34	0.07	0.32	0.07	0.09	0.14	0.12	0.15	0.03	0.08	1631

$\hat{\beta}_x^y$, $y \in \{E, U\}$: Parameter estimates of equation (C.1), $\hat{\sigma}_{\beta_x^y}$: standard deviation of $\hat{\beta}_x^y$, $P_{\beta_H^y=\beta_E^y}$: p-value of the test $H_0 : \beta_H^y = \beta_E^y$ against $\beta_H^y \neq \beta_E^y$, R_x^2: coefficients of determination, T: Number of data points. $\hat{\sigma}_{\beta_x^y}$ are heteroskedasticity and autocorrelation consistent by allying the Newey-West estimator (Lags $= (4T/100)^{2/9}$) for OLS and POLS and consistent for weakly cross-correlated estimators for GME.

Table 47: Adaptive Beliefs (post 1950, non-housing CPI)

	$\hat{\beta}_H^E$	$\hat{\sigma}_{\beta_H^E}$	$\hat{\beta}_H^U$	$\hat{\sigma}_{\beta_H^U}$	$\hat{\beta}_E^E$	$\hat{\sigma}_{\beta_E^E}$	$\hat{\beta}_E^U$	$\hat{\sigma}_{\beta_E^U}$	$P_{\beta_H^E=\beta_E^E}$	$P_{\beta_H^U=\beta_E^U}$	T
AUS	0.53	0.26	0.86	0.28	-0.33	0.55	-0.57	0.96	0.03	0.1	65
BEL	0.57	0.62	-0.06	0.56	-0.7	1.26	-1.51	2.53	0.19	0.24	54
DNK	0.26	0.34	0.31	0.36	0.27	0.86	-1.14	0.76	0.34	0.04	65
FIN	0.61	0.34	0.19	0.62	-1.27	0.68	-1.05	0.92	0	0.16	65
FRA	0.3	0.32	0.26	0.32	-0.01	0.79	-0.65	0.74	0.27	0.14	65
DEU	0.44	0.31	0.93	0.41	-0.84	0.91	-6.44	1.49	0.08	0	53
ITA	1.31	0.31	2.56	0.89	-0.06	0.78	-1.98	1.64	0.04	0.01	65
JPN	0.74	0.32	1.83	0.48	-0.31	0.42	0.1	0.58	0	0	56
NLD	0.51	0.68	0.36	0.4	-1.65	0.87	-1	1.17	0.01	0.13	65
NOR	0.56	0.4	0.27	0.53	-0.5	0.83	-0.95	1.08	0.09	0.15	65
PRT	0.7	0.21	0.73	0.19	-0.1	0.73	-1.71	0.95	0.09	0.01	65
ESP	0.57	0.24	0.42	0.45	-0.89	0.57	-1.5	0.88	0.01	0.02	65
SWE	0.3	0.32	-0.19	0.37	0.1	0.91	-0.1	0.73	0.31	0.35	65
CHE	0.26	0.31	0.72	0.29	-1.32	1.04	-2.84	1.39	0.08	0.01	65
GBR	0.22	0.25	0.3	0.22	1.46	1.03	0.53	1.63	0.33	0.36	65
USA	0.7	0.2	0.44	0.19	-0.62	0.7	-1.74	1.24	0.03	0.04	65
GME	0.54	0.27	0.62	0.7	-0.42	1.58	-1.41	2.89	0.22	0.2	65
POLS	0.62	0.07	0.7	0.18	-0.22	0.36	-0.97	0.45	0.01	0	896

$\hat{\beta}_x^y$, $y \in \{E, U\}$: Parameter estimates of equation (C.1), $\hat{\sigma}_{\beta_x^y}$: standard deviation of $\hat{\beta}_x^y$, $P_{\beta_H^y=\beta_E^y}$: p-value of the test $H_0 : \beta_H^y = \beta_E^y$ against $\beta_H^y \neq \beta_E^y$, R_x^2: coefficients of determination, T: Number of data points. $\hat{\sigma}_{\beta_x^y}$ are heteroskedasticity and autocorrelation consistent by allying the Newey-West estimator (Lags $= (4T/100)^{2/9}$) for OLS and POLS and consistent for weakly cross-correlated estimators for GME.